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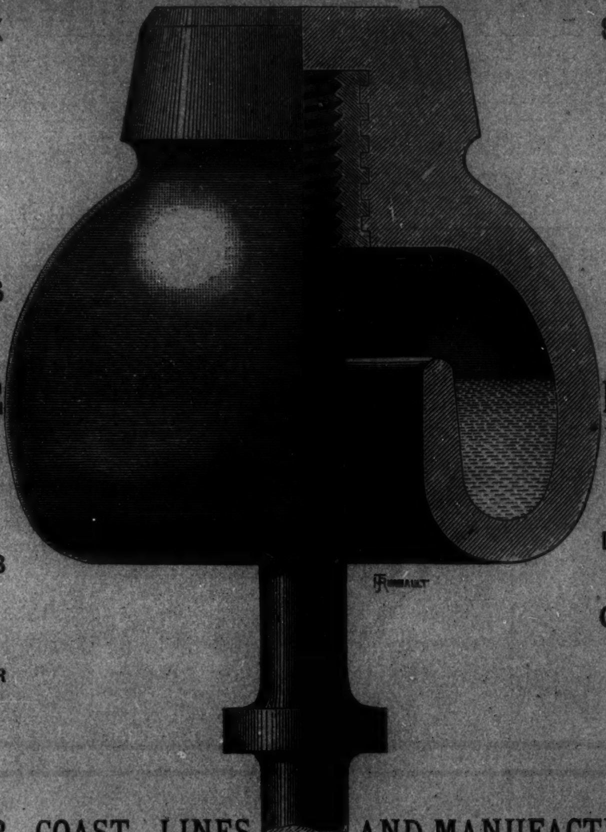

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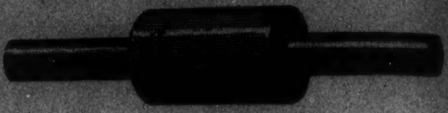

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CONTRACT TENDERS.

THE general principle of inviting tenders from manufacturers either for the supply of materials or for the execution of certain works can hardly be regarded as other than a good one, but the manner in which the principle is carried out in many, and we fancy in an increasing number of cases is not quite so satisfactory. Speaking generally, it would be understood that when tenders are invited the special object in view is to get the best possible work done, or the best possible materials supplied, at the lowest possible price, and this unquestionably is the object aimed at and probably in most cases achieved. It would further be understood that each tender would be carefully examined and then a selection made, thus every manufacturer would have an equal chance of obtaining the order and no individual would have anything to complain of if his tender were not accepted. In a great number of cases, however, we hold that there is distinct cause for objection, as although competition is openly invited there is great reason for supposing that the firm to whom the contract will fall is practically decided beforehand, and that the invitation for tenders is a mere farce to blind the public and the manufacturers into the notion that perfect impartiality exists. We do not mean to say that partiality is carried to the extent of accepting inferior work or that the choice made is other than strictly a correct one. Experience shows what firms may be relied upon to act as closely as possible up to the terms of the contract, both as regards excellence of work and punctuality in executing the latter within the specified time, and naturally such firms are selected. It being known, however, that one particular firm only is really capable of doing what is required, the injustice of inviting a number of others to go to the expense of working out estimates, and possibly manufacturing samples of work, when it is perfectly certain that there is not the slightest chance of their tenders being accepted, is obvious. No doubt the manufacturers themselves are to blame in the matter, for if the work they profess to be able to carry out, has been shown by previous experience as likely to be thoroughly well done and punctually finished, their chances of obtaining a contract would be perfectly good ones, but they often seem to consider that what they must know to be indifferent work may possibly pass muster and that excessive unpunctuality in completing the orders will be condoned. There, no doubt, is much difficulty involved in the question generally, but the fact remains that, good as the general principle is, yet the present system of contract tenders can be regarded, in a very great number of cases, as little more than a farce.

ON THE RESISTANCE OF THE ELECTRIC ARC.

By W. PEUKERT.

CONCERNING the alteration in the resistance of the galvanic arc in accordance with its length, we have the former investigation by Edlund,[*] which was carried out merely with battery currents, and which led him to the assumption of a counter electromotive force, or of a polarisation in the arc itself. More recently[†] we have the researches of Dr. Fröhlich, which gave for the connection between difference of potential (measured at the carbon electrodes) and the length of the arc a linear equation applicable also to the resistance of the arc when it is represented as a quotient of the potential difference and the strength of the current.

The values for difference of potential and length of arc used in constructing this equation were obtained with different strengths of current, and it seemed desirable to carry out certain experiments with a constant strength of current so as to eliminate one of the three variables, *i.e.*, strength of current, difference of potential, and length of arc.

The experiments about to be described were conducted in the electro-technical laboratory of the Technical High School at Berlin. I must express my best thanks to the superintendent of this laboratory, Prof. Dr. A. Slaby, who most courteously placed the necessary appliances at my disposal.

The current was generated by a compound dynamo by Siemens and Halske, and the measurement of the strength of the current was effected by means of a Crompton and Kapp's ampèremeter, which instrument had been previously tested as to the accuracy of its indications.

The carbons, at which the difference was measured in a direct manner with a Siemens and Halske torsion galvanometer were in a differential lamp (Hefner-Alteneck's system), in which the mechanism for regulation was introduced, so that the lamp served merely as a carbon-holder.

The determination of the length of arc was effected by projecting the distance of the two carbons upon a millimetre scale placed close behind them in such a manner that as soon as the strength of the current and the difference of potential had become constant the current was interrupted, and the mutual distance of the carbon was assumed as the length of the arc. A direct measurement of the arc itself always gave too small values, in consequence of an action of irradiation produced by the strongly ignited positive carbon. As the formation of a crater in the positive carbon made accurate measurements difficult, the ends of the carbon were levelled with a file before each experiment, and remained so during the brief time required for reading off. Before each experiment the carbons were brought near the distance intended, and the transition of the current was effected by a small carbon rod placed between them.

The values obtained in these experiments are collated in the following series :—

SERIES 1.

Strength of current in ampères.	Difference of potential in volts.	Length of arc in millimetres.	$\frac{\text{Difference of potential.}}{\text{Strength of current.}}$
Constant 10	39	1	3·9
	41	2	4·1
	45·5	4	4·55
	50	6	5
	54·5	8	5·45
	57·5	9	5·75

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[*] *Poggendorff's Annalen*, Vol. 131, page 586.

[†] *Elektrotechnische Zeitschrift*, 1883, page 150.

SERIES 2.

Strength of current in ampères.	Difference of potential in volts.	Length of arc in millimetres.	Difference of potential. / Strength of current.
Constant 15	43·5	4	2·9
	45·8	5	3·05
	49	6·5	3·26
	55	9	3·66
	57	10	3·8
SERIES 3.			
Constant 20	42	4	2·1
	47	6	2·3
	48	8	2·4
	51	10	2·55
	54·5	12	2·72
	57	14	2·85
SERIES 4.			
Constant 25	44	6	1·76
	46	7	1·84
	47·5	8	1·9
	51	10	2·05
	55	12	2·2
	60·5	14·5	2·42
	63	16	2·52
	72	20	2·88
SERIES 5.			
Constant 30	57	7	1·9
	57·5	8	1·91
	60	10	2
	62	11	2·06
	65	14	2·16
	66·5	15	2·21
	69	18	2·3
	70	20	2·33

The quotients of the differences of potential and the strength of current as given in these tables may be considered as the apparent resistance of the arc. The variation of this resistance with the length of the arc is shown in the diagrams 1 to 5, constructed by plotting out the lengths of the arc as abscissæ and the resistances as ordinates. The lines connecting the points thus obtained have in the five series of experiments the character of right lines, so that for the apparent resistance which we may call W, there is obtained an equation of the form

$$W = a + b\,L \qquad (1)$$

If in each case we determine the numerical values of the constants, a and b, we obtain the following equations :—

$$\left.\begin{array}{lll} \text{Current of 10 ampères,} & W = 3{\cdot}66 + 0{\cdot}23\ L \\ \quad\text{,,}\quad 15 \quad\text{,,} & W = 2{\cdot}3 + 0{\cdot}15\ L \\ \quad\text{,,}\quad 20 \quad\text{,,} & W = 1{\cdot}8 + 0{\cdot}08\ L \\ \quad\text{,,}\quad 25 \quad\text{,,} & W = 1{\cdot}3 + 0{\cdot}075\ L \\ \quad\text{,,}\quad 30 \quad\text{,,} & W = 1{\cdot}6 + 0{\cdot}04\ L \end{array}\right\} \quad (2)$$

Only the four first of these equations can be compared with each other, as in the last series fresh carbons were used, the nature of which may not have been without influence on the numerical values of a and b.

The equations (2) show that the apparent resistance of the arc is composed of two parts, a constant part which varies only with the strength of the current and a second portion which increases proportionally to the length, and can thus be considered as the true resistance of conduction in the physical sense of the word.

If we, in interpreting the constants, a, of the equation (1) assume a resistance of transition in the arc for the passage of the electricity from the carbon to the air, and if we call this resistance per unit of section, U, we have the equation

$$W = \frac{U}{Q} + \sigma\frac{L}{Q} \qquad (3)$$

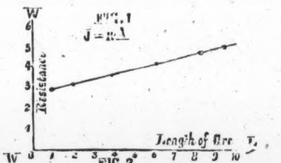
σ being the specific resistance of conduction, and Q the section of the arc. The numerical values which the four first equations in (2) give for $\frac{U}{Q}$ show with sufficient accuracy an inverse proportionality to the strength of the current, thus confirming Fröhlich's assumption in the treatise above cited that the section of the arc increases proportionally to the strength of the current. If we put $Q = a\,J$, then

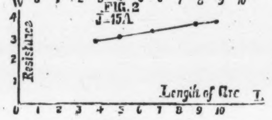
$$W = \frac{U}{a\,J} + \frac{\sigma\,L}{a\,J} \qquad (4)$$

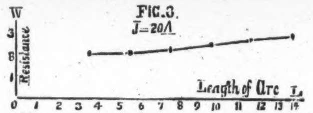
consequently the coefficient of $L\ b = \frac{\sigma}{a\,J}$.

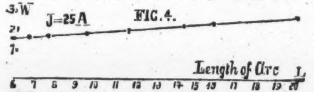
The equations (2) show that b declines more rapidly than the strength of the current increases, which was to be expected, as in strong currents not only the specific resistance of the carbon declines in consequence of the attending elevation of temperature, but the atmospheric air becomes a conductor, and as such must here be taken into account.

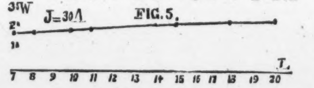
If, on the other hand, we assume a polarisation in the arc the value resulting for it would be a J, as the difference of tension measured at the carbons $W.J = a\,J + b.L.J.$ If we determine this value from the four first of the equations (2), we obtain a mean value of nearly 35 volts. The value thus obtained for this polarisation being considerably greater than all polarisations hitherto known, tells against this assumption. If we, with Edlund, regard as the chief cause of the counter electromotive force in the arc the development of electricity effected by the mechanical subdivision of the two carbons caused by the current, the value of this polarisation, according to all known experiments on the excitement of electricity during the mechanical division of bodies, is far too great to be thus explained. On the other hand, in consequence of this division, as the mechanical effect of the current increases with its strength, the counter electromotive force must also increase with the strength of the current. But this, according to the experiments given, is not the case; they show a constant value for such a polarisation.











If we refer the excitement of electricity in the arc to thermo-electric action in consequence of the unequal temperature of both carbons, or to the circumstance that the carbon electrodes become covered with the oxygen, or respectively hydrogen produced by the decomposition of the watery vapour in the air, so considerable a polarisation cannot be thus explained.

Much more likely is the view that of the total resistance of the arc which presents itself as the relation between the difference of tension and the strength of the current, a part only comes into consideration as the true resistance of conduction, whilst the other, and considerably larger portion is a pure mechanical resistance, the overcoming which is a part of the work of the current. Even the circumstance which speaks most strongly in favour of the assumption of polarisation, *i.e.*, that a certain minimum tension must exist for the origination of the arc can be very simply explained by the circumstance that a certain tension is necessary to loosen the particles of carbon, which then effect a conductive connection between both carbons and thus render the production of the arc possible.—*Zeitschrift fur Elektrotechnik.*

THE USE OF THE CHARGING BATTERY IN TELEPHONY.

By J. W. GILTAY.

IF we connect a microphone and a Voltaic battery with the primary wire of an induction coil, and the ends of the secondary wire with the plates of a condenser, each change in the resistance of the microphone will cause the condenser to be charged in consequence of the difference of potential produced in the secondary circuit.

If the microphone is made to vibrate by a sound, periodical changes of the charge of the condenser will take place, causing corresponding changes in the attraction between the plates of the condenser, so that they are set in vibration and emit a sound. But as the sound produced by the condenser is one octave higher than that which actuates the microphone, the former apparatus will not be capable of emitting articulate sounds.* If we, however, also place in the secondary circuit a battery which charges the condenser to a constant difference of potential, all the sounds produced by that apparatus will be of the same pitch as those which set the microphone in vibration; and under those circumstances the condenser will form an excellent receiver.

Dunand† and Herz‡ were the first to make experiments with condensers as telephonic receivers. The latter has telephoned with his apparatus over a line of 1,100 km. Their condensers consisted of alternate sheets of paper and tinfoil.

Dolbear§ has also attempted to utilise the condenser as a receiver. His apparatus differs in construction from those of Dunand and Herz; it consists, namely, of two thin metal discs of about 5 cm. diameter, fixed in an ebonite box and separated from each other by a very thin ebonite ring.

Professors Bottcha and Snyders having kindly granted me the use of a charging battery of 100 small Daniell cells at the Physical Cabinet of the Polytechnic School, I took the opportunity to make a few experiments with a Dolbear receiver.

Each element of that battery consisted of two cylindrical tubes of 140 mm. height and 22 mm. inside diameter. One of those tubes was filled with copper sulphate and contained a copper wire; in the other tube, which was filled with zinc sulphate, was placed an amalgamated zinc wire, which was soldered to the copper wire of the next element. The two solutions were in connection with each other by means of a U-shaped tube filled with water. The length of each branch of that tube was 10 cm. and its inside diameter was 3·5 mm. As the current must pass through the column of water contained in the tube, the element has an enormous resistance; connecting one element with a reflecting galvanometer of 408 ohms resistance, I found that it produced a current of about $\frac{1}{130000}$ ampere, its resistance was consequently about 130,000 ohms.

The microphone I used in my experiments with Dolbear's condenser was that of Ader, it was connected with a battery of 3 Bunsen cells and the primary wire of an induction coil; the bobbin was 7·5 cm. long and 3 cm. in diameter. The primary wire, 0·5 mm. in diameter, consisted of 4 layers; the secondary wire, 0·07 mm. in diameter, consisted of 19,000 turns and had a resistance of about 7,000 ohms. The condenser and a battery of 20 of the above-mentioned elements was connected with the secondary circuit. Anything now spoken or sung in front of the microphone was very distinctly heard in the condenser, but the sound was rather weak. The following calculation will show that the magnitude of the sound emitted by the condenser will increase with the potential of the charging battery.

When a single sound of the period τ is produced in front of the microphone, each momentary charge of the condenser will be represented by the formula $a+b \sin 2\pi \frac{t}{\tau}$, in which a represents the constant charge communicated to the condenser by the battery. The attraction between the plates of the condenser is proportional to the square of the charge and therefore the force, K, is

$$K = C\left(a + b \sin \pi \frac{t}{\tau}\right)^2 \qquad (1)$$

and as in small motions the extent of each motion is proportional to the force causing it, the amplitude, A, will be according to formula (1)

$$A = C_1\left(a + b \sin \pi \frac{t}{\tau}\right)^2 \qquad (2)$$

As now the value of A increases with that of a, it is evident that a more powerful constant charge will cause a greater vibration of the condenser, which will consequently produce a sound of greater magnitude; and yet I found that when I used 100 elements, instead of 20, the sound became weaker notwithstanding the fact that the value of a was five times as great.

The cause of this was the enormous resistance of the charging battery. A condenser, whose plates are connected with the ends of a wire in which there is a difference of potential, will be charged to the same difference of potential, no matter how great the resistance of the wire is. But with the resistance increases also the time required for charging the condenser to that potential. Let E be the potential of the charging battery, and V the maximum potential produced in the secondary wire of our induction coil by the effect of a sound of constant magnitude on the microphone. In consequence of the great resistance of the charging battery, it will take a certain time to increase the potential of the condenser from E to E + V; and before the condenser has acquired the charge corresponding with the potential E + V, the difference of potential in the secondary wire will have decreased. Let V_1 be the minimum potential of the secondary wire, then it will likewise be some time before the condenser is discharged to the potential $E + V_1$; and before the charge has been reduced to that potential, the potential of the secondary wire will have increased and consequently prevent a further discharge. From this it will be seen that with a great resistance of the line the changes of the potential of the condenser are less than those of the potential of the secondary circuit. The increase of the line resistance will consequently cause the charge to vary within narrower limits, and the condenser will emit a weaker sound.

It is then evident that in formula (2) the value of A may decrease notwithstanding the increase of that of a. The cause of the decrease is the greater resistance of the battery, due to the increase of the number of elements, by which the value of the coefficient, b, is reduced.

The advantage of the use of a charging battery of a high potential is then more than counterbalanced by the disadvantage of the increased resistance of the secondary circuit. It is true that we could meet the difficulty by the use of a battery of less resistance, as, for instance, the Leclanché battery, but then the arrangements would become too expensive and consequently unpractical.

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* See my paper on the Polarisation of Telephonic Receivers, verst, meededul K Ad v Webensch afd natunek 2ᵉ Reeks Decl. XX.

† *Comptes Rendus*, 3rd January, 1881.

‡ Du Moncel le Téléphone, 4th Edition, page 192.

§ *Scientific American*, 18th June, 1881.

I have attempted to construct a condenser capable of being used as a telephonic receiver, in which the magnitude of the sound is independent of the resistance of the charging battery. With such an instrument I thought it would be possible to produce a more powerful sound than with Dolbear's condenser, and I should also have the advantage of being able to use a dry pile of Zamboni as a charging battery. Although the results of the following experiments prove the correctness of my theory, I did not succeed in constructing an apparatus fit for practical use, as it was in that respect, like Dolbear's condenser, far behind the Bell telephone.

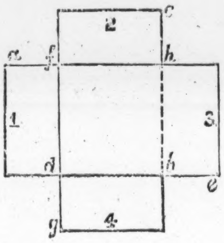

FIG. 1.

My first condenser was constructed as follows:—On an ebonite plate, not shown in the figure, I placed a sheet of tinfoil, *a*, *b* (fig. 1), 8 by 12 cm., across *a*, *b*, a similar sheet, *c*, *d*, was placed; sheets *e*, *f*, and *g*, *h*, were placed as shown in the figure, and so on, until there was a pile of 100 sheets of tinfoil. All those metallic sheets were separated from one another by sheets of paper soaked in melted paraffin; the whole being of the shape of a cross. The ends of each set of sheets were connected with each other by a binding screw.

Fig. 2 shows in what manner this apparatus, which I called the cross-condenser according to its shape, was connected with the circuit. The sets of sheets, 1 and 4, were connected with the charging battery, and the sets 2 and 3 with the secondary circuit. As this condenser had a much greater capacity than that of Dolbear, the telephonic currents by which the sets 2 and 3 were charged could be of a lower potential, and

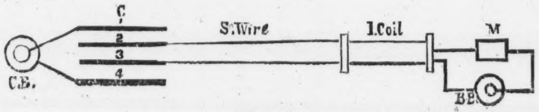

FIG. 2.

I consequently used an induction coil with a secondary wire of less resistance. The primary wire of that coil was 0·45 mm. thick, and consisted of four layers; the secondary wire was 0·16 mm. thick, consisted of 4,350 turns, and had a resistance of 261 ohms. In my experiments with this cross-condenser I used a charging battery of 20 Leclanché cells, which was connected with sets 1 and 4. The sets 2 and 3 were connected with the ends of the secondary wire, and the primary wire was connected with an Ader microphone and a battery of three Bunsen cells. Any words spoken now in front of the microphone were distinctly heard in the cross-condenser, even at a distance of 5 cm. In the case of this condenser the telephonic currents do not, as they do in Dolbear's arrangement, pass through the charging battery, consequently the resistance of that battery will not affect the magnitude of the sound; yet when I substituted the 100 Daniells for the Leclanché battery, the sound emitted by the condenser was totally inarticulate, which proved that the charge communicated by the battery to 1 and 4 was about equal to zero. This was, of course, owing to the bad insulation of the sheets of tinfoil; the battery could not, in consequence of its enormous resistance, produce a sufficient quantity of electricity to make good the loss due to the leakage of the condenser.

In order to prove the correctness of my theory, I had no alternative but to construct an air condenser; when its discs were sufficiently separated from each other it would be possible to use a dry pile of Zamboni, or even a Leyden jar, as a charging battery. I accordingly modified my cross-condenser by suppressing one of the sets of sheets. Fig. 3 shows how this "triangle-condenser" was connected with the circuit, namely, 1 and 3 with the charging battery, and 1 and 2 with the secondary wire. With a charging battery of 20 Leclanché cells this apparatus worked as well as the cross-condenser in fig. 2.

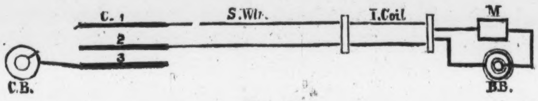

FIG. 3.

Fig. 4 represents an air-condenser constructed on the principle of the triangle-condenser. On an ebonite stand are fixed three uprights, which support three metal discs, A, B and C. A is a copper tympanum, 0·05 mm. thick and 9 cm. in diameter, fixed between two metal rings; B and C are circular metal discs, which can be brought very close to the tympanum by means of adjusting screws. In the figure the three discs are shown far apart from each other for the sake of distinctness; but in reality they are separated from one another by the smallest possible air space. On the plates B and C copper tubes are screwed which hold India rubber tubes, terminating in ear-pieces of wood.

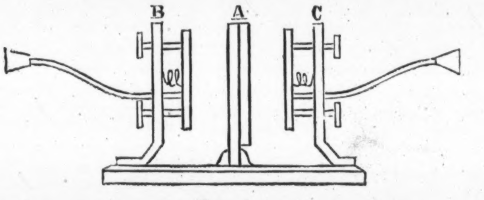

FIG. 4.

In fig. 5 it is shown how this air-condenser is connected with the secondary wire. The tympanum, A, is connected with one of the ends of the secondary wire, the other end is connected with the earth. The disc, C, is connected with one pole of a Zamboni pile, the other pole and the disc, B, are connected with the earth. The induction coil I used on this occasion, the same I used with Dolbear's condenser, had a resistance of 7,000 ohms. The Zamboni pile consisted of 2,200 elements of gold and silver paper. In order to prevent any connection along the edges between the gold and silver paper belonging to the same element, I pasted those discs, which were 24 mm. in diameter, on a very thin paper disc of 29 mm. diameter, thus forming between the gold and silver coating of each element a border of non-conducting paper $2\frac{1}{2}$ mm. wide. The glass tube which contained the pile was coated inside and outside with paraffin.

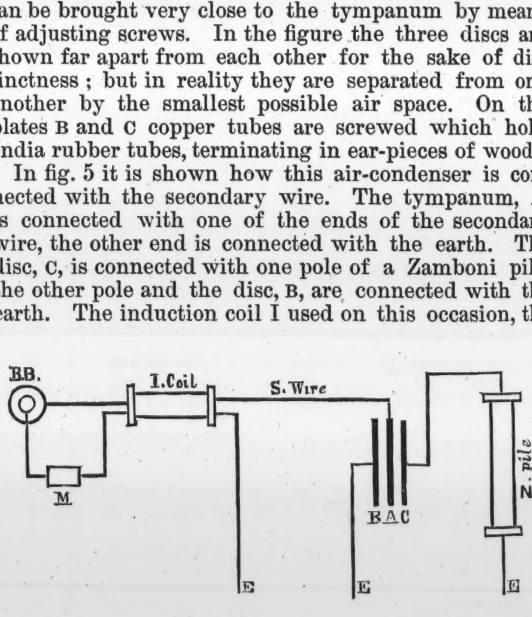

FIG. 5.

If a person now whistled or sang in front of the Ader microphone, every sound was distinctly heard by means of the tubes; also the sound of a musical box was clearly audible. Words spoken clearly and loudly were, if one listened with attention, distinctly heard. As a proof that telephonic communication in this manner is possible through an enormous resistance, I found that when I cut off the communication with the earth the sound, although much weaker, was still clearly heard. The Zamboni pile and the condenser were placed on a table in a room, the temperature of which had been maintained at 22° C. for some hours. The connection with the earth was consequently effected by means of the table and the floor of this dry room.

It is evident that the Dolbear receiver will not be able to produce any sound at all if we place the Zamboni pile *in the line* as a charging battery.

I have not yet made any experiments with the Leyden jar as a charging battery, because my condenser was not adapted to that purpose; for all sharp edges and angles should have been avoided in the construction of the apparatus, and the distances between A, B and C, fig. 4, should also have been greater, in order to prevent the discharge of the Leyden jar.

Delft, *January 6th*, 1885.

ELECTRIC LIGHTING FOR STEAMSHIPS.*

By ANDREW JAMIESON, Assoc. M. Inst. C.E. and F.R.S.E.

ALTHOUGH it is not more than three years since the first application of incandescent electric lighting to the general illumination of steamships, the advantages accruing therefrom have been so fully recognised, that already more than one hundred and fifty ships have been fitted with it, and scarcely a man-of-war or a first-class passenger steamer now leaves the builder's hands without having it on board.

As the dynamo which furnishes the electricity for feeding the incandescent lamps has to be driven at a uniform velocity, neither the ship's main engines, nor the donkey, nor winch-engines, are suitable for the purpose. The dynamo must have an engine for itself. It is, in most cases, necessary to place this special engine and the dynamo in such a position that the men on watch at the main engines can, with a minimum of trouble, also attend to the electric plant.

This position, therefore, is naturally somewhere near the starting platform, and if possible on the ship's floors, so that undue vibration and noise may be avoided. Frequently a convenient recess can be provided, either immediately behind the main starting platform or opposite to the thrust-block, just outside the screw-shaft-tunnel door. Only in large installations will it pay to have on board an electrician solely to attend to the dynamo, its engine, and lamps. In such cases, a convenient and cool position is generally selected between decks, in the same compartment with, or in that next to, the refrigerating machinery, if such should be on board, so that one man may attend to both of these novel appliances.

Where practicable, the axes of dynamos with large, heavy armatures, should be placed fore and aft, to obviate as much as possible the effects of gyrostatic action, since the angular velocity due to rolling is greatest athwartship. In dynamos where the weight of the armature, its velocity, and radius of gyration are small, gyrostatic effects will not produce any appreciable increase of pressure on the bearings, whatever the position of the dynamo.

The following formula, kindly supplied by Sir William Thomson, with examples, will render this matter clear:—

$$\text{L} = \frac{\text{W}\,k^2\,\Omega\,\omega}{g} \text{ and } \text{P} = \frac{\text{W}\,k^2\,\Omega\,\omega}{g\,l}.$$

Where L = moment of couple on axis.
P = pressure on each bearing.
W = weight of armature.
k = radius of gyration about axis.
$\Omega = \frac{2\pi}{\text{T}}\text{A}$ = maximum angular velocity of dynamo in radians† per second, due to rolling of ship.
$\text{A} = \frac{\pi d}{180}$ amplitude in radians per second.
d = degrees of roll from mean position.
T = periodic time in seconds.
$\omega = 2\pi n$ = angular velocity of armature in radians per second.
n = number of revolutions of armature per second.
l = distance between bearings.
g = acceleration due to gravity.

Take the case of a ship rolling 20° from the mean position, with a periodic time of 16 seconds.

$$\text{Then} \quad \Omega = \frac{2\pi\text{A}}{\text{T}} = \frac{2\pi}{\text{T}} \times \frac{\pi d}{180} = \frac{2\pi^2 \times 20}{16 \times 180} = \frac{\pi^2}{72} =$$

0·137 radian per second.

Examples.

With a Siemens S D_0 dynamo machine, running at 600 revolutions per minute, weight of armature 500 lbs., radius of gyration 0·3 foot, and distance between bearings 3·3 feet, the gyrostatic pressure on each bearing only amounts to 3·6 lbs.

With a Siemens (W 16) alternate current machine, running at 1,300 revolutions per minute, weight of armature 148 lbs., radius of gyration 0·7 foot, and distance between bearings 1·4 foot.

$$\text{Then} \quad \frac{\text{W}\,k^2\,\Omega\,\omega}{g\,l} = \frac{148 \times 0{\cdot}7^2 \times 0{\cdot}137 \times 136}{32{\cdot}2 \times 1{\cdot}4} = 30{\cdot}6 \text{ lbs.}$$

To take an extreme case, such as an alternate-current machine, with a heavy armature running at 2,000 revolutions per minute, let the weight of armature be 500 lbs., the radius of gyration 1·2 foot, and the angular velocity of ship's roll in radian per second 0·3. If the distance between the bearings were 1·5 foot, there would be a pressure on each bearing of about 930 lbs. Such a dynamo is not likely to be used on board ship. In selecting a dynamo it is necessary to determine whether or not it fulfils certain requirements:—

I. It must develop electromotive force suitable for a certain lamp, when driven at a definite speed.

II. It must be self-regulating; that is, the electromotive force generated at the given speed must remain constant to within 5 per cent., whether working one lamp or more, or the full number of lamps. It is preferable to have a slight fall in electromotive force as the number of lamps is reduced* (fig. 1).

III. There must be no emission of sparks at the commutator brushes.

IV. When running light, or with less than the full number of lamps, there must be no undue heating of any of the parts.

V. The conductivity of the copper wire with which it is wound must not be less than 96 per cent. of pure copper.

VI. The insulation resistance of the armature and electro-magnets should not be less than 10,000 ohms per volt generated at the required speed.† The dynamo should be tested mechanically and electrically before it is put on board ship, and afterwards, when fixed in position, by a final trial of not less than six hours' duration, with its own engine, and with all the lamps in circuit, before being passed by the electrical engineer.

There is considerable diversity of opinion regarding the limit of speed of a dynamo on board ship. Amongst practical men (ships' engineers in particular) there is a decided objection to speeds exceeding 600 to 650 revolutions per minute. At higher speeds, 1,000 to 2,000 revolutions per minute, which are common in installations on land, the bearings need greater attention, there is more noise, more vibration, and, in a pitching, rolling ship, more gyrostatic action and more tangential inertia, tending to burst the armature. Besides these objections, direct driving of the dynamo-armature from the crank-shaft of a fast-speed engine is very popular, and such engines cannot be relied on at speeds of over 600 revolutions per minute for any lengthened period. As a consequence of this general desire for low speeds, most of the best forms of dynamos, the Siemens, the Edison, the Edison-Hopkinson, the Victoria, the Ferranti-Thomson, and the Pilsen-Schuckert, have been specially modified for ship use, so as to produce the required electromotive force and current, at speeds varying from 400 to 650 revolutions per minute. In order to effect this, their weight and bulk have to be greatly increased, and consequently their weight-efficiency is proportionately reduced. The success or failure of an installation on board ship depends as much upon the engine as upon the dynamo, and every care should be taken to procure one that needs the minimum of attention, and is not likely to break down. The engine should be capable of, say, driving the dynamo during a voyage to Australia and back, without a hitch and without requiring overhauling. The demand for such engines, more especially for those driving direct, has led to the production of a great variety, many of them excellent in workmanship and in detail.

It is frequently necessary that the engine should be capable of doing its work when supplied with steam either from the main or from the donkey-boilers, so that the electric light may be available in port as well as at sea. This entails a capability for working under variable pressures, and thus the size of the engine must be adapted for the lower pressure. A reducing-valve may with advantage be used when working from the main boilers, thus wire-drawing the steam down to the normal pressure of the donkey-boiler.

One of the most important adjuncts to the engine is its governor. It should be sufficiently sensitive and reliable in action to keep the engine within 5 per cent of its normal speed, with a load varying 90 per cent., and a boiler-pressure varying 10 lbs. per square inch. No mechanical governor can do this, and consequently great vigilance has to be exercised on the part of the attendant. A tachometer, or continuous speed-indicator, with a large dial, is usually fitted to or worked from the dynamo-spindle, and a pilot or test lamp is hung between the terminals of the dynamo, or in some easily-seen position, to give warning of any departure from the normal speed and the electromotive force. The author recently heard of a case in which fifty of the two hundred Swan lamps on board a large passenger-steamer were suddenly broken through a failure of the governor.

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* From the proceedings of the Institution of Civil Engineers.
† Radian is unit angle in circular measure.

* Remarks by Author previous to discussion.
† This refers to a dynamo for 100 lamps.

A good electrical governor, which shall automatically open and close the throttle-valve, in perfect synchronism with the load, or work to be done, and leave the valve in its last position until a change is made either in the load or in the steam pressure, is greatly to be desired. The author, having attempted to solve this problem, may be pardoned for describing his design; because, no matter how perfect the self-regulation of the dynamo may be, that alone will not prevent the breaking of the lamps or undue variation in their light, should the engine be improperly governed or attended to.

The electrical governor (Fig. 2) consists of a copper disk, C, D, revolved between the poles of one pair or more of small electro-magnets, E, M, actuating a throttle-valve by means of a spring and cones. The wire carrying the current for exciting these electro-magnets is joined in direct circuit with the shunt wires surrounding the dynamo-magnets. If preferred, it may be connected up in series with, or as shunt or compound-shunt series circuit to, the main circuit feeding the lamps, or advantage may be taken of the magnetic poles of the dynamo. There are, therefore, neither contacts nor unsoldered connections to get out of order. The copper disc is loose on the governor-spindle, and is driven, through the intervention of the spiral spring, S, S, by gearing or by a band passing round one pulley on the dynamo shaft, and another pulley keyed on the governor axle. The centre of the copper disk has a projecting screw on one side, which engages one end of the sliding-sleeve having two-friction cones, F C, F C. Between the friction-cones, F, C, and the throttle-valve, T, V, a device (not shown) exists for preventing an overturning of the throttle-valve to the right or to the left. When all the lamps, say 100, are lighted, and a normal current is passing through the electro-magnets, E, M, the copper disk experiences a certain resistance to rotation due to the Foucault currents generated in it. This resistance is balanced by the spiral spring; but should any number of the lamps, say 10, be turned out, immediately a stronger current passes through these electro-magnets, and simultaneously with this the speed of rotation of the dynamo, and consequently of the governor, is increased, due to the diminution of the load. This combined increase of current and of speed causes stronger Foucault currents to be generated in the copper disc. It therefore experiences more than the normal resistance to rotation. The effect of this is to coil up the spiral spring, S, S, thus bringing the left-hand friction-cone into gear with the larger horizontal cone attached to the throttle-valve, and closing the latter about 10 per cent. Whenever the admission of steam has been sufficiently reduced to suit the altered circumstances of the lighter load, the spring, reasserting itself, causes the friction-cones to ungear, leaving the throttle-valve in its last position until a change is made in the number of lamps. Should more lamps be lighted, a reverse action to that described takes place. The normal current in the electro-magnets is reduced simultaneously with a diminution of speed; consequently the poles, N, S, are less strongly magnetised, and weaker Foucault currents are generated in the copper disk. There is then less resistance to its rotation; this permits the spiral spring to bring the right-hand cone into

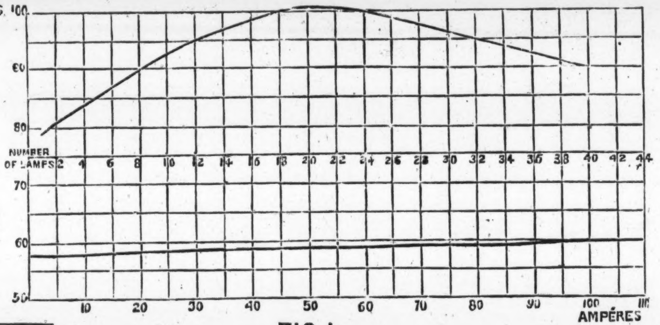

FIG. 1.

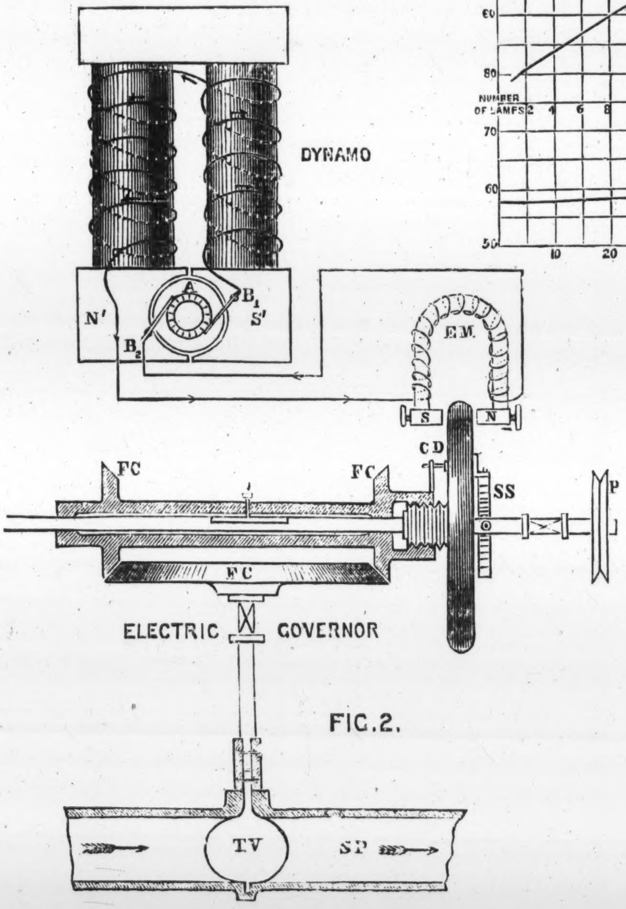

FIG. 2.

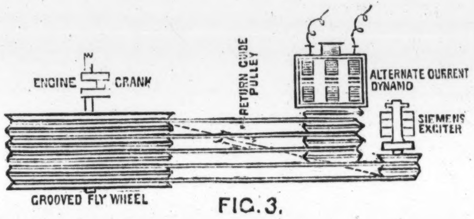

FIG. 3.

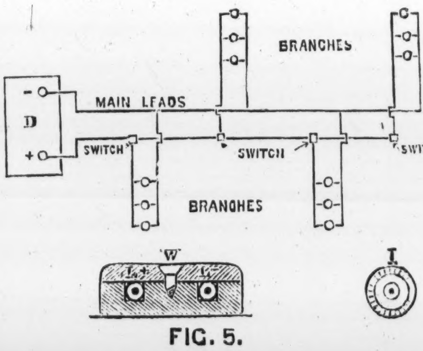

FIG. 5.

FIG. 1.—THE UPPER CURVE REPRESENTS THE ELECTROMOTIVE FORCE OF A PILSEN DYNAMO WITH PACINOTTI ARMATURE AS FITTED ON BOARD SS. "THISTLE," JULY, 1884.

Speed of dynamo, 440 revolutions per minute. Electro-magnets, two wound in series and two in shunt circuit with armature. Shunt magnets, 64 ohms. Series magnets, 0·31 ohm. Armature, 0·54 ohm. The fall in electromotive force from 20 lamps to 1 lamp is an advantage where an ordinary governor is used, but the fall to the right with from 20 to 40 lamps in circuit is a disadvantage. The lower curve represents the electromotive force of compound wound "Victoria" dynamo D2 type, suited for 100 lamps of 20 candle-power, requiring 60 volts electromotive force. The dynamo was maintained at a constant speed, and shows a remarkably straight curve with a slight rise as the number of lamps is increased.

FIG. 3.—PLAN OF COTTON ROPE DRIVE.

FIG. 2.—JAMIESON AND ALLEY'S ELECTRIC GOVERNOR FOR REGULATING THE SPEED OF ENGINES DRIVING DYNAMOS SO AS TO KEEP THE ELECTROMOTIVE FORCE CONSTANT.

N', S', North and south poles of dynamo-magnets. A, Armature of dynamo. B1, B2, Brushes of dynamos. E, M, Electro-magnet of governor with its wires in direct circuit with those of the dynamo-magnet wires. N, S, Adjustable north and south poles of governor electro-magnet. C, D, Copper disk revolving between N, S, and connected by—S, S, Steel spring to governor-spindle which is driven by—P, Pulley direct from dynamo-axle. F, C, Friction-cones or wheels. T, V, Throttle valve, working in, S, P, Steam-pipe.

FIG. 5.—DOUBLE WIRE SYSTEM.

D, Dynamo. W, Wooden casing (cross-section) for carrying and preserving leads (L +, L —) I, Metal pipe (cross-section) for carrying leads in boiler-rooms. The circles represent lamps.

gear, thus opening the throttle-valve to the desired amount. When that is done the cones ungear automatically, and the valve is left in position until a change is necessary. This governor is sensitive and quick in action, does not "hunt," and keeps the electromotive force constant. The position and space available for the engine and dynamo on board ship are the first points which have to be considered before determining the mode of driving which shall be adopted.

Should there be sufficient room between decks near the boilers it is more economical to use a comparatively low-speed engine, with fly-wheel and belting or cotton-rope drive, to obtain the necessary speed from an engine making, say, 150 revolutions per minute. This plan is often adopted. For example, in the ss. *Manora*, lately built by Messrs. William Denny and Bros., of Dumbarton, for the British India Steam Navigation Company, and fitted by Messrs. King and Brown, of Edinburgh, with Siemens direct-current dynamo for 200 Swan lamps, a Tangye engine, running at 160 revolutions per minute, drives the dynamo at 650 revolutions by means of an India rubber belt direct from the fly-wheel.

In the ss. *Chicago*, fitted with electric light by Messrs. Siemens Bros., an endless cotton rope is employed, passing from a broad-grooved fly-wheel to the grooved pulleys of Siemens's alternate current dynamo and direct current exciter. The return to the fly-wheel for the rope is effected by a cross connection under a guide pulley fixed to the floor, as shown in fig. 3.

In all such cases the dynamos are fixed upon slides, and can be screwed backwards or forwards so as to adjust the tension of the belt or rope. Where the belt drive is short, there is also fitted a tightening pulley. This was done in the case of the ss. *Oregon*, fitted by the Edison Company with Mather and Platt's engines and Edison-Hopkinson dynamos. Such methods of driving dynamos take up a good deal of space. It is often necessary to fit the plant into some small corner of the engine room, where it is impossible to provide for a belt drive, and in such cases a direct-driving-engines gearing, or Messrs. Siemens Bros. frictional drive, may be resorted to.

As examples of vessels fitted with direct driving engines, the ss. *Pateena* and ss. *Adelaide*, both first-class passenger steamers, despatched from the Clyde for local traffic in Australasian waters, may be instanced, as their electric light arrangements were carried out by the Edison Company under the supervision of the author.

In the ss. *Pateena* there were 160 Edison 16 candle-power lamps, and in the ss. *Adelaide* 131 lamps of 16, and four of 100 candle-power, the latter being for facilitating the receiving and discharging of passengers and luggage when in port.

In each case the Westinghouse engines and the dynamo were bolted to one cast-iron sole plate placed in a recess near the starting platform on the ships' floors. Their speed was regulated for 525 revolutions per minute, which was found sufficient to generate an electromotive force of 90 volts, giving the required 16 candle-power with the lamps as specially provided. Steam was supplied at pleasure either from the main or the donkey boilers, at pressures varying from 50 lbs. to 90 lbs. on the square inch, the stop valve acting as a reducing valve. Although the best mechanical governors that could be got were fitted, it was found that the speed rose 25 per cent. when 99 per cent. of the lamps were switched out, the remainder being considerably stressed, though not broken during the short space of time that was permitted to intervene before slowing down.

The whole arrangement is exceedingly compact, and has served its purpose admirably in these two ships, the engines only requiring to be looked to every half-hour or so, as they are self-lubricating throughout; in fact, the whole of the lower parts are continually running in oil. The engines are single-acting and the cylinders vertical, so the pressures are always in one direction; pounding is thus avoided, and no adjustment need be made for wear in the bearings. The *Pateena* has been running for more than a year, and the lighting has given entire satisfaction.

Ferranti machines driven by the Westinghouse engine were supplied by the Hammond Electric Light Company to Messrs. William Denny and Bros. for the ss. *Arawa* and ss. *Tainui*, which they have just built to the order of the Shaw, Savill and Albion Company for their New Zealand trade. On each of these vessels a complete double set of Ferranti plant was fitted on one strong cast-iron sole plate. Provision was made for coupling the plant together while running at full speed, 550 revolutions per minute, and thus feeding the whole of the 300 20 candle-power lamps with current at an E.M.F. of 100 volts; or each set of plant could be worked independently, and by a combination of switches either plant could be made to feed any section or set of sections of the ship at pleasure; thus greatly minimising the chance of failure of the light on board.*

Another popular direct-driving steam-motor is Brotherhood's well-known three-cylinder engine, as applied this year to the electric lighting of H.M.S. *Triumph* and the Brazilian ironclad *Riachuelo*. The first adoption of this engine to electric lighting on board ship (arc system) was in 1876, when Messrs. Sautter, Lemonnier & Co, of Paris, fitted up the French ironclad *Richelieu* with a "search light." Since that time the above firm alone has adapted 315 of these engines to electric lighting purposes, of which 242 were for use on board ship, principally for war ships, viz., France 161, Italy 47, Austria 13, Russia 8, Denmark 5, Brazil, Norway, the United States and Turkey 18. Altogether, up to date, 616 Brotherhood engines have been applied to driving dynamos.

Considerable improvements have been made in this engine since it was first introduced, the latest being piston valves, thus doing away with the long steam passages and the leakage through the former kind of disc valve, and a flexible coupling (fig. 4) whereby the stress due to wear of the dynamo spindle bearings, and any untruth in the line of the same with that of the engine shaft, are reduced.

The largest engine of this type that has been applied to dynamo driving is one indicating 42 H.P., running at 610 revolutions per minute, and consuming about 4 lbs. of coal per indicated H.P. per hour.

Mr. A. C. Kirk, M. Inst. C.E., the managing partner of Messrs. Robert Napier and Sons, has applied internal cast-iron gearing, in the case of three large Mexican mail steamers which his firm has lately built, to getting up the necessary speed between the engine and dynamo. The arrangement is strong and compact, there is no chance of slipping, and the noise is tolerably well overcome by encasing the gearing in a wooden muffling box. The whole plant is placed in a recess in the engine room on the ship's floors, where it can be attended to by the men on watch at the main engines.

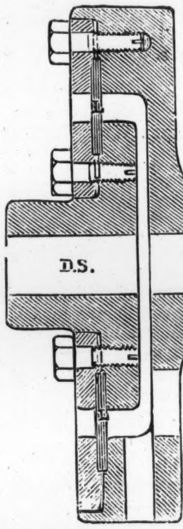

FIG. 4.

E S, Engine shaft. D S, Dynamo spindle. L, Leather disc.

Messrs. Siemens Bros. have lately brought out a compact form of rolling contact or friction drive, thus enabling an ordinary vertical engine to work their direct current compound shunt-wound dynamo at any desired speed. The dynamo pulley, which is covered with papier-mache, is caused to bear evenly on the engine fly wheel by means of two adjusting rods. The dynamo is supported in a cradle on cross-bearings or trunnions, which relieve the armature and its spindle from any stress except that due to the torque necessary to revolve it. This arrangement has given great satisfaction wherever it has been introduced, the only special precaution being to keep the paper pulley dry and free from oil.* There are two systems upon which leading wires may be fitted on board ship, the one with forward and return, main and branch leads, or what may be termed the double wire system, as in fig. 5.

The other system uses the iron plating and beams of the ship as a return for the electric current, and so may be called the single-wire system, as in Fig. 6.

The advantages of the latter system are these: it is less costly, more easily fitted, and offers about one-half the resistance to the current, as only about one-half the length of wire required for the first system suffices. The disadvantages are, that a fault in the insulator or dielectric of the leading wire has a more direct effect upon it than upon the double-wire system, for any accidental connection of the conductor with the iron of the ship at any point, short-circuits the wire at that point. It is also found that if, through the ship leaking, salt water should penetrate the dielectric to the conductor, the latter will soon be eaten through by galvanic action, sub-chloride of copper and soda being formed. Faults of this description have occurred with both systems and given considerable trouble, but with first-class dielectrics, good joints, and by carefully encasing the leads in varnished or paraffined grooved wooden casings, such accidents should not happen, as the conductor would then be protected by a waterproof casing throughout except at the switches and lamps. The ss.

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* Remarks by author previous to discussion.

* Remarks by Author previous to discussion.

Arawa and ss. *Tainui* are examples of ships wired on this system, but extra care and the very best insulated leading wires have been used throughout, as verified by the author's tests.*

All joints in the leads should be carefully made by experienced workmen. They do not require to be so well done as in submarine telegraphy, as they have not to withstand the water-pressure, and the requisite insulation-resistance is not so high; nevertheless the metallic junctions should be thoroughly well soldered, the dielectric ends cut down to a taper with a sharp knife, and thereafter the whole covered with wrappings of felt, pure rubber, and waterproof tape, being finally varnished. †

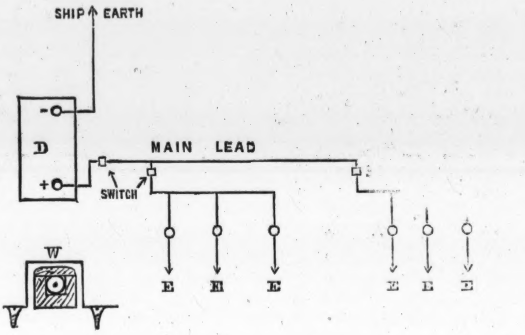

FIG. 6.—SINGLE WIRE SYSTEM.

D, Dynamo. W, Wooden casing for carrying and preserving leads. E, Earth-connections. S, Switches. The circles represent lamps.

It is most important that the size of the conductor should be sufficient to carry the necessary current without causing more than 2 to 3 per cent. loss of the electrical power developed in heating them. Sir William Thomson's law for bare conductors, viz., not less than 1 square centimetre for 50 ampères, which is based on the principle that the total loss is a minimum when the two component losses are equal, *i.e.*, when the annual cost of power wasted in heating the conductor is equal to the yearly interest plus depreciation on its value, is too liberal an allowance of copper in the case of well-insulated short leads; besides which he has omitted to add the insurance on the value of the wire which, in the case of ships' fittings, amounts often to 7 per cent. The author has used a rule which he finds to work well in practice for ships' leads where the length is never great, viz.:—

"The conductor to be of best copper of not less than 95 per cent. of the conductivity of pure copper, and to have a cross section of 1 square millimetre for every ampere and a half of current passing through it (which is at the rate of about 1,000 amperes to the square inch); the insulation resistance of the whole circuit when fitted including all switches, &c., to be not less than 1,000 ohms per volt of electromotive force generated by the dynamo."

Before fitting the wires, specimens of not less than 100 feet should be selected, immersed in sea-water, or brine-water, for 24 hours, and then carefully tested for insulation resistance, and not passed unless they give over 10 megohms. Specimen joints should be treated in the same way and give at least 100 megohms each.

Although the above rule for the size of conductors is considerably in excess of that required by theory for mere safety from heating, and not applicable to large and long district mains, it has been found in practice to give excellent results in small installations on board ship and in houses, where the maximum current conveyed by any leading wire does not exceed 300 amperes, and the farthest lamp is not more than 100 yards from the generator. The required sizes of the conductor are easily calculated or found direct from the Tables ‡; those for even single lamps are of sufficient size and strength for rough handling. There is not the slightest danger from heating in any part of the circuit, and the rule is economical when applied to the best class of insulated leads. Based upon this rule, in the following Table will be found the most common sizes of leading wires used in ship installations, and which the Author is in the habit of handing to contractors working to his specifications.§

It is seldom that on board ship more than 300 amperes are generated by any single dynamo; and, as several main leads usually spring from the dynamo room to various parts of the ship, the current in any one of them seldom exceeds 100 amperes, so the wires do not vary greatly in size, and generally four sizes will suffice for a ship.

TABLE FOR SIZES OF SHIP LEADS (WELL INSULATED).

For Swan 20 Candle-power or Edison 16 Candle-power Lamps.

Maximum number of lamps to be carried.	For 45 to 60 volt lamps requiring 1·5 to 1·1 ampères.	For 90 to 110 volt lamps requiring 0·8 to 0·6 ampères.
	Board of Trade wire gauge; branch leads.	Board of Trade wire gauge; branch leads.
1	No. 18 wire	No. 20 wire
2	„ 16 „	„ 18 „
3	„ 15 „	„ 16 „
10	„ 10 „	„ 12 „
	Main leads' strand.	Main leads' strand.
20	7 No. 15^s.	7 No. 16^s.
25	9 „ 15^s.	7 „ 16^s.
45	19 „ 16^s.	7 „ 14^s.
60 to 70	19 „ 14^s.	19 „ 16^s.

Insulation resistance is too often neglected by electric light engineers. Amongst submarine telegraph engineers it is considered of vital importance to watch the insulation resistance with the most rigid accuracy, not only during the manufacture of a cable, but during its submersion and after it has been laid; whereas in the case of electric lighting, those charged with the fitting up of an installation very seldom think of, or even know how to take, insulation tests, either of the dynamo or of the leading wires. The Author has found great difficulty, in most installations with which he has been connected, to get the contractor to recognise the importance of this test; in fact, he has only met with one instance in which the contractor himself used testing apparatus which would detect a small flaw in the insulation of the wires after they had been fitted. To this general neglect of testing conductor and insulation resistance may be attributed some of the failures that have occurred.

It is far from right to allow leads to be run up like bell wires, without the slightest knowledge as to whether a flaw or a fault has crept in, and all engineers should insist upon rigid inspection, as well as thorough and searching tests, before an installation is passed. The insulation resistance standard need not be nearly so high as in the case of submarine cables; but nevertheless it does require to be several hundred times more than the copper resistance, otherwise a fault will soon develop, and short-circuiting occur, under the combined influences of the electromotive force and damp or wet.

The dielectric should, therefore, in addition to being a good insulator, be thoroughly watertight, and as little liable as possible to be affected by atmospheric changes. There are three methods of arranging the main switches on board ships, the first by having all situated in the dynamo room, whereby the circuits are wholly controlled by the man attending to the engine and dynamo. The second, by having one main switch to control the whole current, near the dynamo, with the others situated where the different main circuits branch off, so that they can be turned off or on by the ship's servants as required. The third method is to have main switches, not only in the dynamo room, but also at the base of the different departments. The last plan introduces unnecessary complication, and the first can only be carried out when all the different circuits spring direct from the dynamo room. The second is more general, and serves all requirements now that self-regulating dynamos have been introduced, and if care be taken that too many of the circuits are not put in or cut out at one time, so as to overtax the powers of the engine governor. In most installations each lamp is fitted with a switch, so that every passenger may turn on or off his light at pleasure, which is no doubt convenient for the passenger; and after the novelty has passed away there need be little fear, in a well-regulated ship, that the privilege thus afforded will be unduly taken advantage of, or the switches or lights tampered with. One of the best and simplest forms of these small switches, introduced into this country by Mr. H. C. Harold.* The merit of this switch is that it remains hard on or hard off as the spiral springs act on each side of the dead point. The contacts are scraping contacts and can be easily cleaned.

An excellent form of main switch, as fitted by Messrs. William Denny and Bros. into the Shaw-Savill steamers, is shown in Fig. 7, where double spring scraping contacts are provided on each side, and the lower contact projects beyond the upper one, so that any accumulation of dirt due to "sparking" on opening or breaking circuit may be readily removed by cleaning it with emery cloth.

Fusible or safety wires should be introduced into all the main and branch circuits. The size for the branch circuits being such that they will give way before the current becomes dangerously strong for the smallest leading wires of the section. In most instances the small safety "cut-outs," which some firms introduced in circuit with each lamp, did not act so as to save the lamps from destruction. To guard an Edison or Swan lamp, requiring one ampère or less, from breaking through excess of current, the fusible wire, to be of real use, would have to be so very fine as to be difficult, from a mechanical point of view, to handle or replace. A neat method of overcoming this mechanical difficulty has, however, been fitted into the ss. *Manora*. A thin narrow strip of tinfoil in the form of a double hook or S, is pasted on a piece of insulite to stiffen and support it, each end of the S being fixed down by means of a screw, whereby the current feeding the lamp has to pass through the tinfoil. Its dimensions are such that it will fuse with about twice the normal current required for the lamp.

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* Reply to discussion.

† Detailed rules for making joints in electric light leads. "Munro and Jamieson's Pocket Book of Electrical Rules and Tables," p. 230. Third edition. Also remarks by author previous to discussion.

‡ "Munro and Jamieson's Pocket Book of Electrical Rules and Tables," pp. 178, 217-222, 223-226. Third edition.

§ Reply to discussion.

* This is the Lundberg switch illustrated in the REVIEW for August 16th, 1884.—EDS. ELEC. REV.

All fusible wires or "cut-outs" should be so fitted that they can be readily inspected and replaced by fresh ones when required. They should be as short as practicable, so as to increase the resistance of the circuit as little as possible.

In choosing the kind or form of lamp to be used, there is so little difference between the efficiency and lasting powers of those of the different makers, that the chief things to be attended to are, that they should be of the required candle-power when supplied with the current and electromotive force of the selected dynamo.

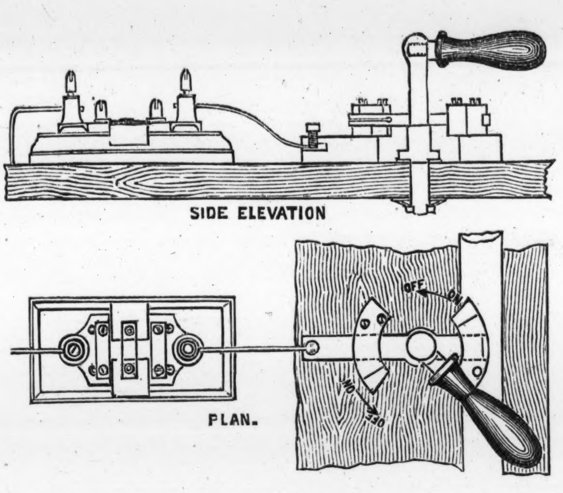

FIG. 7.—MAIN SWITCH ARRANGEMENT, SS. "ARAWA," WITH HEDGES' FUSIBLE BRIDGE.

Scale ⅓.

Lamps of 10 candle-power are sufficient for most cabins, of 20 candle-power for saloons, music rooms, smoke rooms, boiler and engine rooms, and of 50 or 100 candle-power lamps for side lights, masthead lights, gangways and hatchways, or a cluster of 20 candle-power lamps.

It is important that the holders for the lamps should enable good, easy, but firm contacts to be made between the terminals of the lamp and the leads, and that the vibration of the ship should not work the contacts loose or permit of the filament being unduly shaken, which action is found considerably to reduce the life of the lamps.

Lanterns and globes have been designed, not only for use on land, but also for ship purposes, and in this respect the electrician has been ably assisted by those who make it their business to provide these appliances. Such appurtenances should be both elegant and durable, and be fixed so that the light is shed downwards on the passenger, rather than hung on a level with his eyes, the most approved plan of lighting being to suspend short brackets with their globes from the ceiling over the centre of the tables, so that they are clear of the passage-ways and wine-glass holders, and distributed so as to give a uniform light, as in Messrs. Siemens Bros. fittings, which have given great satisfaction. The original plan of fixing the electric lamps inside or attached to the oil lamps is in great measure discontinued, as an unnecessary complication. In some steamers, where the cabins enter off the saloon, devices such as lanterns of triangular section have been resorted to. By this means the cabins and the saloon are simultaneously lighted, but in this respect each particular shipbuilder or owner has more to say than the electrical engineer. In the engine-room, lanterns with reflectors and wire-cage protectors are largely used, as well as lamps attached by flexible leading wires, to permit of the engineer inspecting different parts of the machinery. In the boiler-rooms the lamps are so fixed as to cast their light directly upon the water-gauge glasses, that the height of the water in the boilers may be readily and easily observed from the stokehole floor.

Arc lamps are seldom used on board passenger steamers, but they have been found of great use in telegraph steamers in facilitating paying out, picking up, and repairing operations when conducted at night, and in spotting "mark buoys."

They are largely used in foreign navies, as well as on board British men-of-war. In such cases the arc light is placed inside a revolving holophote case (fixed upon the bridge or well forward), and fitted with a lens and reflector, so as to throw a concentrated beam of light in any desired direction, with the view of inspecting an enemy's position, or of guarding against the attack of torpedo-boats. Such lights are worked from a separate dynamo, and require to be at least 10,000 to 20,000-candle-power. They have been applied successfully by Messrs. Siemens Bros., the Silvertown Company, and by the Anglo-American Brush Company to English men-of-war.

A novel application of the arc light for salvage and fishing purposes has been fitted by Messrs. Paterson and Cooper to the ss. *Tilly*, for fishing in Batavian waters. The installation* consists of a Gwynne vertical engine, supplied with steam from the ship's main boilers, a Phœnix dynamo, and the submarine lamp of 15,000-candle-power. This is the only instance known to the author of the adaptation of the electric arc light to submarine purposes, but if the idea is practicable and successful there is ample scope for its application.

Electric lighting installations on board ship, as well as on land, should be thoroughly well carried out in every particular. Many of the disappointments, failures, and accidents which have occurred have been caused by want of knowledge or carelessness, either on the part of those ordering plant or of those executing orders. The author recalls to memory Mr. Preece's well-timed caution, in his paper on "Electrical Conductors," where he says:—"It cannot be too strongly urged that specification without rigid inspection is valueless. . . . Many administrations object to the expense of thorough inspection, and the result is they are the recipients of the rejected material of those who do rigidly inspect."

(To be continued.)

THE PHŒNIX FIRE OFFICE RULES FOR ELECTRIC LIGHT INSTALLATIONS.

THE sixth edition of the rules prepared for the "Phœnix" Fire Office by Mr. Musgrave Heaphy, C.E., for the regulation of electric light installations has been published, and as various modifications, additions and re-arrangements have been made since the issue of the fire office rules which were reproduced in the ELECTRICAL REVIEW some three years ago, we deem the following of sufficient importance to be placed in full before our readers:—

"Rule No. 1. All conductors in a building to be so placed as to be thoroughly and easily inspected.

"No. 2. All conductors to have sufficient sectional area so as to allow at least 50 per cent. more electricity being safely sent through them than will ever possibly be required for the lights they supply.

"No. 3. No naked conductors allowed in a building.

The frame work of arc lamps is not included under the term "conductor."

"No. 4. All conductors should be thoroughly well insulated with a material, or materials, rendered as non-inflammable as possible, and which will not too readily become plastic; and the insulation should be protected by coverings of a substantial and durable character. To be approved by the Inspector from the Fire Office.

Conductors merely insulated with cotton, or cotton treated with paraffin wax (or analogous substances), will not be allowed, unless under very special circumstances.

"No. 5. In non-hazardous risks, the conductors having been thoroughly well insulated, as described under rule No. 4, should, where practicable, be enclosed in wood casing; and the conductors should be kept apart by a continuous fillet of wood, or other rigid non-conducting material, at least 3 inches wide in the case of the mains, and 1 inch wide in that of the small branches. Where casing is not used, the mains should be kept 6 inches, and the small branches 2 inches apart; and no conductor should be less than 2 inches from all other wires, metals or conducting substances, unless special precautions against contact have been taken. Where external injury is possible, the conductors must be enclosed in metal, earthenware, or terra-cotta tubes; or slate, or wood casing.

"Where 'arc' conductors are not enclosed, and especially when the current is of high potential, the distance they should be kept apart from each other, and from all other wires, metals, or conducting substances, ought to be at least 6 inches.

"In hazardous risks, all conductors should be further protected. Having been thoroughly well insulated as before described, they might be laid in slate casing, or in cement, or in separate metal, earthenware, or terra-cotta tubes, and, under special circumstances, the spaces between the conductor and the tube filled in with a high insulating compound. The mains should not be less than 4 inches apart, nor the small branches less than 1 inch apart.

"To be approved by the Inspector from the Fire Office.

Where from nature of circumstances it is found impossible to follow out any part or parts of rule No. 5, then the Inspector from the Fire Office will decide as to what shall be done in each particular case.

The small conductors about lamp fittings cannot always comply with rule No. 5. The work, however, in connection with them, must be of a thoroughly secure character, and be done to the satisfaction of the Inspector from the Fire Office.

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* This was described in the REVIEW for May 17th, 1884.—EDS. ELEC. REV.

"No. 6. All conductors passing through floors or partitions must be insulated and enclosed in metal, earthenware, or terra-cotta tubes, in the manner described under rule No. 5.

In non-hazardous risks, wood casing may be employed, except under those circumstances when, in the opinion of the Inspector from the fire office, wood casing would not be desirable.

In passing through party walls separating two risks, provision must be made so that the conductors cannot be a means whereby fire can be communicated from one risk to the other.

"No. 7. All conductors passing through the exterior walls of buildings must be insulated and enclosed in metal, earthenware, or terra-cotta tubes, in the manner described under Rule No. 5; and the insulating material must be perfectly impervious to moisture.

"No. 8. All conductors in a building that are exposed to moisture must have a waterproof covering to their insulating material; and the coverings must be of a substantial and durable character.

"No. 9. Overhead conductors must, unless permission to the contrary is given, be insulated; and the insulation must be of a waterproof character. The insulation, method of fixing, general arrangement, &c., to be to the satisfaction of the Inspector from the Fire Office.

"No. 10. The fastenings of conductors should be composed of an approved non-conducting material. Where metal staples are used, a piece of felt or India rubber should be inserted between the head of the staple and the insulation of the conductor. Staples, however, ought never to be used, saddles being preferable.

In the case of external conductors, the fastenings ought always to be composed of a non-conducting material.

"No. 11. When two conductors are joined together the junction must be soldered.

Rosin should be used when soldering.

"No. 12. No ground circuit allowed.

"No. 13. Wherever a branch is led off a main conductor to supply current for one or more incandescent lamps, a short length of lead, or other fusible wire, must be inserted between the main conductor and one end of the branch; and the lead or other fusible wire must be of such section and nature, that if the current passing through it exceeds the normal current by 50 per cent., then it will fuse and disconnect the branch.

By "branch" is meant any conductor leading from another of larger section. The mains themselves must be protected in a similar manner, as near the dgnamo as possible. It is as well to place these 'cut-outs' both in the positive and negative conductors. In very hazardous risks this must be done.

"No. 14. All 'connections,' 'cut-outs,' and 'resistance coils' must be placed in such a secure manner that no danger can arise in the event of their heating.

Switches, for instance, must always have an incombustible base.

"No. 15. All lamps, switches, or any bare connections, must be so mounted, that leakage of electricity from them is rendered impossible.

"No. 16. No naked lights allowed. If 'arc lights' are used, the globes must be enclosed at the base, and have chimneys so arranged that no sparks or flame can escape. The globes must also be covered round with wire netting.

"No. 17. No dynamo or other machine for generating electricity to be placed in any working room of any cotton, woollen, flax, jute, or corn mill; or in any mill or factory of a like description; or in any working room, or place, where any hazardous process is carried on, or in which any hazardous goods are stored. Unless permission to the contrary be given.

By working room is meant, any room or place in which the raw material is undergoing any process tending to convert it into a more finished condition.

The steam engine room, or the mechanics' shop, for this purpose would not be considered as a working room.

"No. 18. A shut-off should be placed at or near the place of entrance of the conductors into a building when the supply of electricity is derived from an external source. When the source of supply is internal, then the shut-off should be placed in the dynamo room.

"No. 19. All work to be of a substantial character, and put up in a thorough workmanlike manner, and to be accurately tested at the time of erection for insulation.

"No. 20. In any electric light installation in which the current has an electromotive force of 200 volts or under, no portion of such installation should ever have a less resistance, so far as the insulation is concerned, than 10,000 ohms. The minimum insulation resistance for currents of high electromotive force, will be decided with regard to each particular case as it arises.

Nothing is here stated as to what the insulation resistance should be when the conductors are first laid, so many instances having occurred of the insulation breaking down after a short period. A statement of the insulation tests must be supplied if required.

A good rule to follow when laying the conductors, is to so arrange them, that they would still be practically insulated in the event of their insulating coverings getting worn away or removed.

"No. 21. When the electric light is intended to be used, full particulars of the proposed installation and all its details must be given. This must be accompanied by samples of the conductors, with a statement of the maximum current to be sent down each, and the electromotive force of the said current: in order that the conductive capacity of the conductors may be judged; as well as to ascertain the quality of the insulation, at what temperature it would become plastic, and its inflammability. Samples of the 'cut-outs' may be required, should the description of them be obscure, or unsatisfactory."

As an appendix to these rules, Mr. Heaphy has compiled a list of "Useful facts to be remembered" in connection with electric light installations, which will be found of interest both to the engineer and to the general user.

REVIEW.

Traité Elémentaire de la Pile Electrique. By ALFRED NIAUDET. Troisième edition revue par HYPPOLYTE FONTAINE, et suivre d'une Notice sur les Accumulateurs, by E. HOSPITALIER. Paris: Librairie Polytechnique Baudry et Cie, Editeurs, 15, Rue des Saints-Pères.

The new forms of batteries which from time to time make their appearance would apparently indicate that considerable progress is being made in this section of electrical science; this, however, can hardly be admitted to be the case. No single battery yet brought out possesses all the elements, or anything like all the elements, of a perfect form. Almost every chemical, every element, and every combination of chemicals and elements under the sun has been tried to enable perfection to be approached, but a galvanic battery still remains a most unsatisfactory producer of electrical power. Either "local action," "polarisation," "low electromotive force," "high resistance," "want of cleanliness," "tendency to give off disagreeable fumes," are one or other of the characteristics of all the batteries yet designed. Practical chemists have tried their best to obtain a satisfactory cell, but their knowledge has not enabled them to do any better than their less scientific compeers. A really satisfactory battery is apparently to be a production of the very distant future. To enable further improvements to be made, a knowledge of what has been previously done is very essential, and this requirement the "Traité Elémentaire de la Pile Electrique" affords. No doubt the entire history of the Voltaic pile is not given completely, but there are very few links left out. As compared with previous editions there is naturally much additional matter and notably a short though well-written notice on accumulators, by M. Hospitalier. The fact that M. Hippolyte Fontaine is the editor of the third edition is a guarantee of its comparative completeness.

Electrical Measuring Instruments.—The new microhmmeter of M. Louis Maiche is, as its name indicates, an instrument for the measurement of resistances, which it is capable of determining with great exactness. The instrument consists of a magnetised needle, balanced on its centre, and placed between two coils of equal resistance wound in opposite ways, so that, when they are in connection with a battery, the needle remains at zero. If we require to measure a resistance, we insert it in the circuit of one of the bobbins. The needle will now deflect, but we can bring it back to zero by moving the other bobbin further away from the needle by means of a micrometer screw, until zero is again obtained. When the instrument is properly graduated, the value of this displacement will be equal to the resistance required. The instrument is easily manipulated, and it is said to be very exact, as it eliminates certain chances of error to which a Wheatstone bridge is liable, such as imperfect contacts made by the metallic plugs. M. Maiche claims that his apparatus is capable of measuring resistances from $\frac{1}{2000}$ ohm upwards. It may be, but for strict reliance upon the results, give us the Wheatstone bridge and mirror galvanometer in preference.

Another International Exhibition.—At a meeting held in Edinburgh last week it was resolved to hold an International Exhibition of Industry, Science and Art in that city in the summer of 1886.

NOTES.

Correction.—In our last report (March 7th) of the Proceedings of the Society of Telegraph Engineers and Electricians, some remarks by Mr. W. E. Langdon, in the discussion on Mr. Timmis's paper, were accidentally attributed to Mr. Lancaster Owen.

Lighting of the Glasgow Dispensary.—At the annual meeting of the subscribers to the Glasgow Public Dispensary last week, Principal Jamieson, of the Science and Arts College, in seconding a vote of thanks to the staff of the institution, mentioned that he had lately come into contact with the medical staff in connection with their desire to obtain the electric light in their premises, with the view of more easily and precisely examining the patients, and he was glad to say that by a combination of circumstances they were likely to get it soon, and at a minimum cost. Mr. John Turnbull, jun., C.E., Bath Street, had given a small "Hercules" turbine; Mr. Groves, of Messrs. Henry Bennett & Co., Hope Street, had agreed to place his dynamo and fit up the whole arrangement without any trade profit; and the Lord Provost had very kindly arranged for the supply of water gratis. As the application and arrangement of this small installation was somewhat novel, he would explain it. The turbine, which was not much larger than a breakfast cup, was to be placed on the floor of the sunk flat immediately below the dispensary consulting room. The dynamo was to be fixed on a level with the turbine at some 3 feet distance, and driven by means of five or six cotton cords. A vertical iron rod would pass direct from the turbine to a position close to the physician, so that when he was examining the patient he might with the greatest ease turn on or off the water, and start or stop the dynamo at a moment's notice. Two leading wires would pass direct from the dynamo to the electric lamps, which could be either fixed to the doctor's forehead or placed in a suitable holder with lens and reflector for directing the rays of light to the part to be examined.

Electric Light for the Suakim-Berber Railway.—On account of the heat of the climate much of the work connected with the construction of the proposed railway from Suakim to Berber will have to be carried out in the night-time, and it is intended to use electric lighting at the points where the workmen are engaged. Messrs. Lucas and Aird have contracted with Messrs. Kitson and Co., engineers and locomotive builders, Leeds, for the supply of two sets of portable electric lighting plant. What is wanted is apparatus that shall be as much as possible self-contained, and capable of being readily moved along the line of operations. Messrs. Kitson have designed plant that will pack into two ordinary railway trucks, built to run on a 4 feet 8½ inch gauge. As the water supply may not be over-abundant, it has been necessary to choose a type of engine that is economical in steam consumption, and with this view Parson's patent high-speed engine has been chosen. By each engine a feed-pump is driven to supply water to the boiler, which is of the locomotive type. The dynamo, which is of the Brush type, and which will be driven at a speed of 1,000 revolutions per minute, is placed on the top of a feed-water tank. This will assist in keeping it cool during the work. The working parts of the machinery are well covered in and protected from sand. The lamps are 2,000 candle power each, and are provided with a double set of carbons to burn for 16 hours. They will be hung from iron tripods 32 feet high, eight of them being ranged in a line alongside the portion of the railway under construction, a distance of about thirty yards intervening between each. Thus a good light can be thrown over about five hundred yards length of line. The tripods are made of light iron tubing, and are jointed at the top, so that the legs can be folded together for transport. The insulated cables will be coiled on portable reels, from which they can be unwound as required. A series of switches are fitted along the cable to which the branch wires to the lamps will be connected, and it will be possible by means of these to extinguish and detach for removal to another position any one or any number of the lamps without interfering with the working of the others. Although the order has only been in the hands of the firm for about ten days, the work has been pushed forward so rapidly that one set is nearly completed, and will be despatched for shipment in a day or two.

Electric Light at Harrogate.—The following report was submitted by the lighting committee to a meeting of the Harrogate Town Council on Monday last:—(1) That the contract with Messrs. Fraser and Henry was to supply and maintain eight arc lamps of 1,000-candle-power for three months—November to January—for three hours per night (Sundays excepted), for the sum of £50, or £6 5s. per lamp, which contract had been duly fulfilled. (2) That six of these lamps had been placed in the Market Hall; that in the opinion of the committee the lamps were of too large a calibre for the purpose, the light being in parts of the market too intense, and in other parts insufficient; that the same amount of light better distributed by means of more lamps of less power would have been ample, both for the market and the shops, and would have lighted the market more effectually than gas, whilst the cost was about the same, the charge for gas during the three months being £40, and the cost of six arc lamps, at £6 5s. each, being £37 10s., the time during which gas is burnt being slightly in excess of the hours stipulated for the electric light. (3) That two of the arc lamps were erected and lighted in the public streets; the one in Station Square was well adapted to the locality, and effectually lighted it; the committee are of opinion that, in the streets as in the market, more lamps of smaller illuminating power would answer better than the larger ones, and better distribute the light, thus moderating the intensity of the light and the contrasted shadows. The committee have not sufficient data from which to offer any opinion as to the cost of the electric light for street lighting as compared with the cost of gas; but they do not think it would be more expensive than gas, if incandescent or smaller arc lamps are used. (4) Some private consumers were supplied with the incandescent light, for business purposes, without consulting your committee. It is understood that in all cases the light so supplied gave great satisfaction. In conclusion, the committee express the hope that the time may be very near when this beautiful light will be offered on terms and conditions which will lead to its general adoption, both by public and private consumers.

Electric Lighting in Glasgow.—The Gas Committee of the Glasgow Town Council is about to try the electric light on a small scale.

Train Lighting in Germany.—Train lighting by electricity has been undertaken in Germany, where some trains on the Frankfort-Fulda-Elm line are now fitted up with a dynamo placed in the baggage car on one side and accumulators on the other side. The dynamo, if driven at 750 revolutions, gives a current of 12 ampères, which by an automatic switch is sent into the accumulators. The dynamo is driven from one of the axles of the van, in a similar manner to the plan adopted on the London, Brighton and South Coast Company's trains. The cost of installing the plant is given at £125 for dynamo, driving gear, and accumulators, and at 65s. to 80s. per passenger coach. The light itself is estimated to cost ·85 of a penny per lamp-hour.

Electric Lighting in Yorkshire.—The installations in Bradford and other Yorkshire towns, which, at the meeting of the Simplex Electric Light Company which we reported last week, were stated to have been carried out by that company, were, we are since informed, erected under the superintendence of Mr. F. F. Bennett, the company's electrician.

The Electric Light Convention in America.—The electric light convention at Chicago is particularly called, according to the circular sent out by the committee, for the benefit of those interested in the business of electric lighting; not especially the manufacturing companies, but all interested in the operating of electric light plants. It is desired that a conference of those interested as above should be held, that there may be a general interchange of ideas to the end that the most perfect as well as the most economical method of operating may be brought out. The following are some of the principal questions to be discussed:—"Switching and different systems of switchboards employed. General care of electrical apparatus. 1st. Dynamos. 2nd. Lamps. 3rd. Lines. Construction and maintenance of lines. Aerial and underground lines. The fuel and carbon questions. Complaints of consumers, and any and all other questions which may properly come before such a meeting. Those to attend are requested to note and be prepared to bring to the attention of the meeting any peculiar circumstances which have come to their notice with especial reference to their particular locality, and also any climatic influences. Several eminent electricians are expected to be present, and much valuable information will be gained by an attendance."

The Principles of Electric Lighting.—An excellent paper by Mr. Sidney F. Walker, entitled, "On the Principles of Electric Lighting, and the Construction and Arrangement of Electric Light Apparatus," has been published as an excerpt from the proceedings of the North of England Institute of Mining and Mechanical Engineers. The paper is profusely illustrated.

Lighting of Telephone Works.—An installation of half a dozen Thornton arc lamps has been for some weeks lighting the works of the Consolidated Telephone Construction and Maintenance Company, in Farringdon Road, an Edison dynamo supplying the current. The lamps are spoken very highly of by the general manager, Mr. Mason, who informed us of the intention of the company to extend the installation.

The Gülcher Light in New Zealand.—The Gülcher electric light has been successfully installed in New Zealand on one of the West Coast gold fields, the Ross United Gold Mining Company's works having been lit up by it. The light, given from two arc lamps of 3,000 candle-power and a score of incandescent lamps, was steady and brilliant, and the dynamo was driven at the rate of 730 revolutions per minute by a turbine worked up to 7 horse-power. Photographs were taken by the aid of the light. The directors of the company were highly satisfied with the result.

Henley's Ozokerited India Rubber Cables.—The Commissioners of the Inventions Exhibitions have recently purchased from W. T. Henley's Telegraph Works Company, Limited, a quantity of the company's patent ozokerited India rubber electric light cables to the extent of £800.

The Storm and the Aberdeen Telephone System.—With reference to the letter from Mr. Bennett, manager of the National Telephone Company in Scotland, which appeared in our last issue, contradicting a report furnished by our correspondent in Scotland, that "the Aberdeen telephone system collapsed" during a recent storm, we have this week received further accounts from our correspondent, taken from different and apparently reliable sources, which are all to the same effect as that published by us, giving prominence to the same facts as ours.

The Lundy Island Cable.—The Lundy Island telegraph cable has been successfully repaired, and is now in operation. Vessels which wish to be reported to their owners are requested to hoist their signals to the station.

Plymouth Postal Telephone Exchange.—In reply to a memorial from the Plymouth Chamber of Commerce complaining that the Post Office authorities had committed a breach of faith with the subscribers to the Telephone Exchange in Plymouth in sanctioning the establishment of another Exchange in that town when it had been distinctly stated by the representatives of the Department that if the Post Office opened an Exchange in Plymouth it would not license another Exchange there, Mr. Patey writes on behalf of the Postmaster-General that at the time when the officers of the Department arranged terms with the subscribers to the Plymouth Exchange, it was well understood that the policy of the Department was to prevent the telephone companies from opening an Exchange. The statements made by the Postmaster and other officers were therefore in accordance with the facts as they stood. In consequence, however, of urgent representations sent up from various towns, and especially from Plymouth, the late Mr. Fawcett was led to modify his policy on this point so far as to do away with any limitation of the towns or radius over which the companies might carry on work. Availing themselves of this concession, the United Telephone Company has opened an Exchange in Plymouth, but the Postmaster-General does not admit that the action of his predecessor in yielding to the demands ostensibly made on behalf of the public, constitutes a breach of faith with the subscribers to the Post Office system whose positions are rendered no worse than if the former restrictions had been maintained. The *Western Morning News* assumes that Mr. Shaw-Lefevre is responsible for the "repudiation" contained in Mr. Patey's letter. The document is so singular in its character and contents that if it came from any less authority it would be laughed at. The *News* adds: "A breach of contract has been made for which the Post Office is clearly liable; and although possibly an action for damages could not be sustained against the Department, it is clear that the Post Office subscribers are absolved from their engagements and liabilities by this breach of contract, which is not—so saith Mr. Patey—a breach of faith."

Telephoning from Balloons.—It is suggested that in war time balloons may be made of the greatest advantage in an action by conveying to the general in command telephonic information of the most desirable nature, and practically to give him a *coup d'œil* over the whole scene.

Reis the Inventor of the Telephone.—At Gelnhausen, in Cassel, Germany, a bust is to be put up of Philipp Reis, "the inventor of the telephone." It will stand on a pedestal of Swedish granite before the house in which he was born. The bust, modelled by the sculptor Karl Rumpf, of Frankfort, will be cast in bronze at Munich. There is already a monument to Reis at Friedrichsdorf, bearing a portrait medallion, also by Rumpf, and erected by the members of the Physical Society of Frankfort.

The Telephone in Sweden.—Stockholm has 4,035 subscribers to the telephone; Gottenburg, 738; Malmo, 355; Nordkœping, 208; Upsala, 139; Orebro, 100; while 43 smaller towns likewise possess installations. In December, 1882, the entire number of subscribers throughout the country was 1,554; now it is 7,976, and the number is daily increasing. The General Telephone Company of Stockholm is constructing a new central station for 7,200 lines.

The Telephone in Perth.—The National Telephone Company has already secured 130 subscribers to its new exchange at Perth, and is fast making the connections.

Telegraph Revenue.—The receipts of the telegraph service from April 1st, 1884, to March 7th, 1885, were £1,610,000; against £1,605,000 taken from April 1st, 1883, to March 8th, 1884.

The Superintendent of Telegraphs, New South Wales.—Mr. E. C. Cracknell, Superintendent of Telegraphs, and Major of the Torpedo Corps, New South Wales, is now in this country, and was last week a guest at the dinner of the Dynamicable Society. He has for about 28 years been head of the Electric Telegraph Department of New South Wales, and during his period of office has introduced the quadruplex system, as well as many other improvements. Under his supervision, too, the electric light has been extensively utilised in Sydney, the installation of that mode of illumination having been successfully effected in the Parliament Houses, the Post and Telegraph offices, the railway station, and around the Circular Quay. Mr. Cracknell has also rendered highly valuable services in connection with the scientific branch of the War Department, including the manipulation of torpedoes. He is commissioned to represent the colony at the International Telegraphic Conference which is to be held at Berlin.

Telegraphic Communication in Canada. — Telegraphic communication along the north shore of Lake Superior by means of the Canadian Pacific Railway line, connecting the eastern provinces with the west, was effected on Saturday night, January 24th, when the first messages were transmitted from north-west points to Ottawa.

Post Office Telegraph Reserve.—It has been decided by the War Office authorities to increase the reserve of Post Office telegraphists from 50 to 70 officers and men.

Telegraphists for the Soudan.—On Monday morning a detachment of 15 trained telegraphists of the Royal Engineers' Reserve of the Post Office Volunteer Regiment, who are about to proceed to the Soudan, was paraded at the General Post Office and addressed by the Postmaster-General prior to its departure for Aldershot. The Postmaster General, after expressing the hope that the men would behave themselves in the same honourable, gallant, and admirable manner in which their comrades who had already gone out to join Lord Wolseley's corps had, according to all accounts, behaved themselves during the campaign which had already taken place, said they would be attached to the Royal Engineers corps, and would, no doubt, be posted between Suakin and the advanced posts of the army as it gradually advanced. He presumed most of them would be there throughout the summer, and possibly during the autumn campaign. Lieutenant-Colonel Taylor, on behalf of the detachment, thanked the Postmaster General for his reception and his words of farewell. He felt quite certain that the men would do their duty thoroughly well, and he thought he might say that in the Royal Engineers they had no men who could approach these as regarded efficiency in telegraphing. Every day telegraphing became a still more necessary adjunct to the army than formerly; and it was very interesting to know that Lord Wolseley would command the army of the Nile and that at Suakin from his headquarters at Korti, a proceeding which could only be effected by the great efficiency to which the telegraph service had been brought. The men present were drawn both from London and Edinburgh, and he did not know what the army would have done unless the Postmaster General had permitted that organisation to be formed. He believed there was hardly a telegraphist left in this country belonging to the Royal Engineers, and without that organisation there would have been great difficulty in providing for duties of that kind in the present campaign. He was glad to say that the War Office had sanctioned the extension of the force to 100 men, and, with the Postmaster General's permission, that number of men would be enrolled. The Postmaster General, accompanied by Lieutenant-Colonel Taylor and Major Thompson, then conversed individually with the men, who later in the day left for Aldershot to join the Royal Engineers preparatory to embarkation.

Telegraphic Extension.—A Glasgow contemporary learns on good authority that the postal authorities in that city are opening a large number of new district offices for the transaction of postal and telegraph business. The step is believed to be taken with a special view to the forthcoming introduction of sixpenny telegrams. It is believed that a large business will be done in purely local telegrams sent from one district of the city to another. The writer continues:—"The department must be prepared to cope with the local telephone companies, who are making arrangements to give facilities for this class of business at a very low rate, and there is little doubt that in the course of a short time the Post Office will be compelled to transmit local telegrams at a minimum rate—threepence, or less—as is done in France and other Continental countries."

The Telegraph Interrupted in Spain.—The correspondent of the *Standard* at Madrid stated last Saturday that telegraphic communication had been almost entirely interrupted with the rest of Spain and with foreign countries for 48 hours by the severe gales which had been raging on the coasts of the Peninsula and throughout the whole kingdom.

The Telegraph in Cochin China.—A curious installation of overhead telegraph lines has been lately completed in Cochin China by the French Administration, *Engineering* says. The river Mekong, which cuts Cambodge and Cochin China in two, has regular floods of nearly 40 ft. in height, lasting four or five months each year, and during these periods the currents have a terrific velocity, destructive to almost everything on the banks or in the stream. Heavy telegraph cables, sunk each year at low water, are regularly carried away by the floods, rendering communication almost impossible during a considerable portion of the year. The engineer in charge of the lines recently decided to fix on each side of the river at a spot where the width is 2,560 feet, posts 165 ft. high. Silicious bronze wires are suspended from these posts across the stream. Bronze wires of another type had previously been used, but these were destroyed by lightning, which stretched them considerably and reduced their diameter to such an extent that their resistance gave rise to considerable heating when an atmospheric discharge traversed them. Since these wires have been replaced by others of silicious bronze, no mishap has occurred, and during the last flood direct communication across the river and between the terminals of the line was maintained for the first time since a telegraph station had been established at Saigon. At the present time the high posts referred to above carry two wires of silicious bronze, one ·04 in. and the other ·055 in. in diameter. A similar crossing has been also completed over a broad tributary of the Mekong, the span of which is 1,670 ft. The height at which the wires are suspended leaves sufficient room for steam vessels navigating the river to pass, the clear headway in times of flood being 114 ft., and at low water 154 ft.

Extensions in Siam.—With reference to the extension of the telegraph in Siam, it is stated that the new Bangkok-Tavoy line will be completed this year. A line from Bangkok to Chieng-mai (Zimmé) in the north of Siam, is also to be constructed, the line being about 600 miles long.

Revival of an Old Scheme.—A French officer of engineers proposes that submarine cables shall be supplied at convenient intervals with short branches, the free ends of which shall be buoyed in such a manner that passing vessels, provided with the necessary batteries and with a key by which to obtain access to the wires, may telegraph home. It is stated that experiments to test the feasibility of the scheme are about to be begun, and several branches are being attached to the cable which connects Algiers with Marseilles.

Consolidated Telephone Construction Company.—A hasty glance through the works of this company with which we were favoured on Thursday revealed a surprising amount of vitality in an industry which receives, comparatively speaking, such little support in this country. An imposing edifice fronts the Farringdon Road, in which are the offices of the company, testing and wiring rooms, and other departments, and at the rear of this is an extensive factory, literally crowded with machines and *employés*. Mr. G. A. Mason, the general manager, conducted our representative through the factory, and courteously explained the various operations which engaged the attention of the large staff. In addition to a large number of lathes, drill presses, &c., our attention was directed to the following special machines:—Two screw-making machines, capable of making from 1,000 to 1,500 screws or terminals per day; another machine capable of making from 4,000 to 5,000 small screws per day; an automatic punch press, to make 90 blanks per minute up to 6 in. diameter; a punch press for small work, capable of making 150 blanks per minute; an automatic tapping machine, which will tap from thirty to fifty holes per minute; a universal index milling machine, and a gear cutting machine. Perhaps the most interesting of the productions of the company displayed for our inspection was an arrangement of the telephone for use by divers, constructed for the Admiralty authorities. A transmitter is so fixed in the head gear of the diver that he experiences no difficulty in speaking at any moment, the line running through the ordinary signal rope. The whole apparatus is compactly arranged in a box of easily portable dimensions. A large number of these telephones is under process of construction for the English Government, whilst also orders have been received from the Russian Government and from private firms. The trade of the company is far from being confined to Great Britain, for which, however, it possesses the absolute right of sale, manufacturing largely for the United Telephone Company and the Post Office. Very extensive business is done in Austria, Portugal, Egypt, India, Australia, China, Japan, and the River Plate. The company contemplates considerable developments, and is desirous of securing apprentices, to whom special facilities and opportunities are offered.

The Albert Medal.—The Society of Arts invites its members to forward names of such men of high distinction as they may think worthy of the honour of receiving the Albert Medal, which is to be awarded for this year in May next. The medal was struck to reward "distinguished merit in promoting arts, manufactures or commerce," and has been awarded, amongst others, to the following in past years: In 1866, Prof. Faraday; in 1867, Mr. (afterwards Sir) W. Fothergill and Prof. (afterwards Sir) Charles Wheatstone; in 1874, Mr. (afterwards Sir) C. W. Siemens; in 1876, to Sir George B. Airy; in 1879, to Sir William Thomson, and in 1880, to Mr. James Prescott Joule.

Wiring the Inventions Exhibition.—We learn that Messrs. Walter T. Glover & Co., of Manchester, have secured the contract for the supply of conductors for the forthcoming exhibition at South Kensington. The well-based reputation of this firm will be sufficient guarantee for the thoroughness with which the work entrusted to them will be carried out.

Lighthouse Illuminants.—In the House of Commons last week, Mr. Gray asked the President of the Board of Trade whether it was the fact that the illuminant experiments at the South Foreland were to be discontinued next month, and how soon the report of the Elder Brethren of Trinity House might be expected. Mr. Chamberlain replied that the experiments, as a whole, would, as at present arranged, be discontinued this month, but the report of the Elder Brethren, being dependent upon the receipt of intelligence from many observers, would occupy some time in completion.

Secondary Batteries.—In reference to the subject of secondary batteries, which has been under discussion for some time in *Engineering* and in our own columns, Mr. J. S. Sellon writes as follows:—"That the matter between Mr. Maxwell-Lyte and myself may be better understood by those who have not ready means of reference I would say a few words on his letter of the 23rd ult. Without wasting time in discussing the absurdity as to whether the claim for 'any chemical process' for a specific preliminary purpose, can be supposed to embrace a well-known 'electro-chemical action' employed for a totally distinct and secondary purpose, I will simply give the words of my specification which alludes to *roughening* the plates, viz. . . . 'in such a manner that to a suitable depth on each side of the plate a spongy layer or projecting points or surfaces are produced, which are either suitable for retaining the material hereafter to be made active, or *for obtaining a more rapid formation of the plates* if used without such packing,' and the words of Messrs. Elwell Parker's specification of nearly a year later, viz. . . . 'The nitric acid oxidises and dissolves some of the lead and causes a roughening, corroding, or honeycombing of the surface whereby the *plate is made capable of having formed upon it*, and retaining when so formed a larger proportion of peroxide of lead during the action of the battery than if the plate were employed with its surface in the originally smooth condition.' The subsequent process of 'formation' by the electric current upon which Mr. Maxwell-Lyte persists in building up his contention *does not and cannot* produce the same effect of roughening or honeycombing the plate as specified above, and is neither claimed by myself nor by Messrs. Elwell-Parker. I challenge him to prove that M. Planté did, as he says, anticipate me in the employment of plates of the form I describe and claim in my patent of September 10th, 1881. That M. Planté was not himself aware that he had done so is evident, for he only patents in June, 1882, and describes in his paper read before the Academy of Sciences in August of the same year (more than eleven months after the date of my patent) the, to him, new and beneficial form of plate *roughened before forming* in order, to use his own words, '*notably to shorten the process of formation*.'"

Personal.—Professor W. Grylls Adams, M.A., Cambridge, F.R.S., Professor of Natural Philosophy at King's College, London, and past president of the Society of Telegraph Engineers and Electricians, has been elected a member of the Athenæum Club.

The British Association Meeting.—The local committee appointed for receiving the British Association at Aberdeen next September is making rapid and satisfactory progress with its arrangements. A sum of about £2,000 has been guaranteed towards defraying the local expenses connected with the meeting.

Gas Charges.—We understand that Mr. S. C. Lister, of Manningham Silk Mills, Bradford, has intimated to the gas supply committee of the corporation that unless a reduction is made in the price charged for gas to him he will commence the manufacture of gas himself. Mr. Lister's gas bill amounts to over £3,000, notwithstanding that the electric light is also extensively used.

City and Guilds of London Institute.—Prof. Silvanus P. Thompson, of University College, Bristol, has been appointed principal and professor of physics at the Finsbury Technical College. The duties of principal have hitherto been discharged by Mr. Philip Magnus, the director and secretary of the institute, who temporarily undertook them, pending the complete organisation of the college. As professor of physics at Finsbury Professor Thompson succeeds Professor Ayrton, who has now been appointed professor of physics at the Central Institution. Now that he makes the metropolis his home Prof. Thompson will doubtless find more ample scope for the employment of his scientific knowledge and inventive skill.

Scottish Legal Case.—William Campbell Muir *v.* Benjamin Pryor Stockman.—The pursuer and appellant is proprietor of the estate of Inistrynich, Argyllshire, and the defender is a civil engineer in London. Stockman contracted to fit up an installation of electric lighting at Inistrynich. While engaged in this work he and his son resided for some time at Inistrynich. The installation contract, as our readers are aware, formed the subject of litigation some time ago; and since then Mr. Muir raised this action, in which he claims £58 16s. as board and lodging for Stockman and his son; £28 for time and work done by a plumber engaged by pursuer, which work he alleges ought to have been done by defender's workman as being part of the contract; and £100 as the sum that would have to be expended in restoring and repairing the electric lighting apparatus damaged by defender on making an inspection of the appliances after the complaint of the inefficiency of the installation was made. The Lord Ordinary (Fraser) disallowed the first claim, on the ground that the treatment and terms of the defender's residence and that of his son at Inistrynich were such as plainly to indicate that they were there, not as boarders, but as guests. On the second claim his lordship allowed only £3 10s. 2d. for material (solder, lead, &c.) supplied by the plumber to the defender; and on the third claim a sum of £15 was allowed, being the estimated cost, as reported by an expert, of repairing the damage to the apparatus complained of. His lordship allowed expenses to neither party. The pursuer appealed, and now their lordships adhered to the Lord Ordinary's decision, and gave additional expenses.

Gas at Bradford.—At last Tuesday's meeting of the Bradford Town Council a proposal to purchase the private gas works of the trustees of the late Sir Henry W. Ripley, Bart., at a cost of £32,000 was rejected. It was argued that the time for such a purchase was inopportune. It would be quite possible for Messrs. Ripley to introduce electric lighting in their factory after disposing of the gas plant, and the council would then be left in the position of having paid £32,000 for the privilege of lighting by gas some two hundred cottages.

Overhead Wires.—The Select Committee of the House of Commons to consider the law relating to the control over telephone, telegraphic, and other wires in public thoroughfares, consists of Sir A. Gordon, Sir J. M'Garel-Hogg, Mr. Torrens, Sir H. Tyler, Mr. Gray, Mr. Firth, Mr. T. Dickson, Mr. Tottenham, and Mr. G. Russell. The committee is empowered to examine witnesses.

The Great Eastern Steamship Company, Limited.—In a petition for the winding up of the company, and also an action by the company's debenture-holders for enforcing their security last week, Mr. Justice Chitty made an order in accordance with the claims of the debenture-holders, and also the usual compulsory order for winding up the company.

NEW COMPANY REGISTERED.

Railway Electric Switch and Signal Company, Limited.—Capital £50,000 in £10 shares. Objects: To carry on the business of contractors, electricians and engineers, and to manufacture all appliances used in connection with electricity, magnetism or other power, whether applied to railways, telephones, electric machines, lamps, the management of railway signals, points, cross-overs and interlocking apparatus or any other purposes. Signatories (with one share each): D. Maitland Yeomans, Kinsman, Ohio, U. S. A.; I. A. Timmis, C.E., 2, Great George Street, S.W.; J. Nield, 1, Ashburn Place, South Kensington; Stanley C. C. Currie (electrician), 75, Jermyn Street; F. Newton, 16, King William Street; J. B. Ball, 1, Gresham Buildings; Edwin Fox, Millwall (wire manufacturer); H. T. Nell, 5, Great Winchester Street (secretary). The signatories are to appoint the first directors; qualification 50 shares, remuneration £1,000 per annum, to be increased to £1,400 per annum when the number of directors exceeds five, and an additional £100 for every 1 per cent. dividend declared above 7 per cent. per annum. Registered 10th inst. by Newman, Hays & Co., 31, Abchurch Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sir Coutts Lindsay and Company, Limited.—By a resolution of the company, dated 7th inst., the nominal capital has been increased by the addition thereto of the sum of £3,000 in £1 shares beyond the original registered capital of £7,000. This resolution was duly filed on the 9th inst.

Bull's Continental Power Company, Limited (Manufacturers of Gas, Electric and Steam Appliances).—The first return of this company made up to the 20th of November, was filed on 9th instant. The nominal capital is £1,000,000 in £1 shares, the whole of which have been taken up and the full amount has been called thereon. Including the shares taken as the purchase money by the vendors, the calls paid amount to £980,000, leaving £20,000 unpaid. Registered office, 3, East India Avenue.

Hungarian Gold and Silver Reduction Works Company, Limited.—An agreement, dated 9th inst., between the Electro Amalgamator Company, Limited, and this company, provides for the allotment of deferred shares of the nominal value £41,665 to certain nominees of the Electro Amalgamator Company instead of to that company direct as provided in an agreement of 20th December, 1883.

Anglo-American Brush Company, Limited—An agreement, dated 7th inst. and filed on the 9th inst., provides for the allotment of fully paid £5 shares in pursuance of clause 5 of an agreement made with the Great Western Electric Light Company, Limited, on 3rd November, 1884, whereby it was agreed that each member of the Great Western Company should be entitled to require the Anglo-American Company to allot to him at any time within three months from the date thereof, three fully paid £5 shares in respect of each £20 fully paid share held by him in the Great Western Company.

New Telephone Company, Limited.—The statutory return of this company made up to the 16th of January, was filed on the 4th inst. The nominal capital is £120,000 in £5 each, but the only shares at present issued are the seven subscribed for by the signatories to the memorandum and articles of association, and upon these no call has as yet been made. Registered office, 4, Great Winchester Street.

CITY NOTES, REPORTS, MEETINGS, &c.

Australasian Electric Light, Power and Storage Company, Limited.

An extraordinary general meeting of this company was held at the offices, 41, Coleman Street, E.C., on Tuesday, Mr. Latimer Clark presiding, for the purpose of receiving the report of the directors and the accounts to 30th June last, and to consider the report of the committee of conference appointed at the meeting held on December 30th last.

Mr. J. H. Duncan, the secretary, having read the notice convening the meeting,

The Chairman said they had met to adopt the report of the directors and the accounts, and to consider the report of the committee appointed at the meeting on December 30th to confer with the directors as to the past history and present prospects of the undertaking. The committee issued their report on the 21st February, the directors sent out a circular on the 26th February, and a sort of reply on the 4th March. That committee was appointed in pursuance of a suggestion made by the board in the report which he hoped they were going to consider and adopt that day. It stated that they would "welcome the appointment, either of another nominee of the shareholders (preferably a large holder of original shares), to join the board, or of a small committee of consulting shareholders, to advise in the place of Mr. Hammond," and the committee was accordingly appointed "to confer with the directors as to the past history, the present position, and the future prospects of the company," and in order to discuss with the board "several matters now in course of negotiation which are hardly ripe for public discussion." The board knew that they had managed the business of the company honestly and to the best of their ability, but they still felt that there should be some outside assistance, either in the form of additional directors chosen by the shareholders or in the form of a committee, who, though having the name of a committee of advice, should have opportunities of looking into all matters since the formation of the company, and thus give confidence to the larger shareholders, to whom, of course, their duties were more particularly due. Whether wisely or not, they decided to invite such a committee, and consequently it was formed, and had now given in its report. That committee was chosen from those gentlemen who spoke in the most hostile manner at the last meeting; therefore, they could not be accused of having packed the committee for any purpose. The board were not unconscious that they had the support of the large body of shareholders when they laid their report before them. Although the motion appointing the committee was carried by the votes in the room, the majority in favour of it was very small, there being 11 for and 9 against it; but the directors did not think proper to vote, because they wished the investigation, and, moreover, they did not wish to raise the question of proxies, of which they had a very large number. They voluntarily and of their own choice called in and asked for a committee of those shareholders who appeared most dissatisfied with their management. Alluding again to the larger shareholders, the board had been somewhat blamed for allowing such a committee to be brought into existence, as it was said that the interests of the company were not served. Perhaps, had they foreseen all they knew now, they might have held up their hands against the appointment, but they had nothing to conceal, and felt it their duty to bring it into existence. They were very much gratified that they had done so on one account, that it had enabled all the shareholders to see that at any rate there had been no wilful wrong, nothing which could be pointed out as improper or very injudicious, in their management. Unfortunately the report of the committee found its way into some of the papers, and excited a little enquiry amongst those with whom they had financial dealings, and no doubt it would get into the colonies, and must do the company harm. He hoped it would do good as well to counterbalance the evil effect; it certainly did good inasmuch as it would clear them as directors. His only subject of regret with respect to that report was, that the committee, having had full access to the documents, and having read them as far as they were able, had not communicated to the directors the opinions and views they had formed, because if they had done so he had no doubt many of those views would have been very much modified and changed. They were perfectly unable, in the time they devoted to the subject, to read any of the correspondence on which the actions of the board were based; they had to take merely the committee minutes and form their opinions from them. They were quite justified in doing so, but they naturally fell into such errors as anyone else would do in the same case. As they had formed those conclusions, and as they declined to communicate what their conclusions were, and sent the report out to the shareholders without the board seeing or knowing what it was, of course they had no alternative but to make a reply such as they could in a brief way. That was the situation they now had to deal with. The report, really and practically, contained only one recommendation, which was that the board should resign as a body. (Hear, hear.) He very much regretted to inform those gentlemen who wished them to do so that they did not think it in the interests of the company to do so. They had an indication that the large body of shareholders, however much a certain portion of them might think differently, were of the same opinion as themselves. Proxies had been sent out and had been returned, and they showed an overwhelming balance of opinion in favour of their retaining their seats. (Hisses.) He was afraid they would not hiss them out. One other suggestion was made, with reference to the directors' fees, and these two were the only practical suggestions; the rest was mere animadversion upon their past management. Before speaking on this, he would remark upon another matter. With respect to past management, he was compelled to admit that they had committed the greatest blunders—the shareholders as well as the directors. ("We are the victims.") They had all been carried away by the mania, enthusiasm, madness, which prevailed at the time, and which none of them could look back upon without regret and even shame that they had not clearer heads and eyes. There was an excitement such as occurred probably only once in a century—there had been nothing similar since the South Sea bubble—and they were all carried away by a violent enthusiasm which it was difficult now to realise. He might mention that after their agent had gone to Australia some highly responsible people here came and offered £20,000 for the right to their patents in New Zealand. They would suppose now that they would have accepted that offer; to-day they certainly would do so but then they simply bowed the gentleman out, and said they were sorry they could not do so. With regard to the directors' fees, they were asked by the committee to strike out the sums which stood to their credit in the profit and loss account. They had always been perfectly frank about this matter. They had stated that they would never take the money left to suspense account unless the company earned a dividend, and they were still of the same opinion. They rather resented being dictated to by the committee; they (the committee) naturally felt they must justify their appointment and show that they had achieved something equivalent to the trouble they had taken. The board declined to do more than they had already said; they would never take that money unless the company was earning a dividend, and they were even prepared to reduce the amount, but beyond that they declined to go under the peculiar circumstances of the case. He hoped they would feel that the directors had dealt with them in perfect fairness, and appreciate their reasons for declining to say more than that. The great object at the present moment was to avoid a call, and he hoped shareholders would be careful to say nothing to damage the interests of the company in future. He might say that the tide seemed to be turning; there were promises of remittances from Australia, and negociations were going on for some very large new contracts, and therefore they looked with some pleasure to the future. He would like to make a personal remark; the committee expressed their surprise that he should allow himself to be placed in a position which they considered a dual one. In that they were somewhat mistaken; there was nothing of the kind in the matter. The interests of the firm he represented and those of the company were identical; they were close partners, and no profit could be made in the one without being also made in the other. It was true they heard afterwards of disagreements, and that the directors wished to terminate the arrangement between the two; when that occurred he certainly was in a dual position, but one which he could not have foreseen very well. He admitted the justice of the board's contention, and whenever the matter was under discussion he retired from the board, and never spoke to any director upon the subject, nor to the secretary or his clerks.

Mr. Wainwright said the chairman had plumed himself a good deal upon the way in which he had conducted the business of the company. It would not do to go forward to the world that they thoroughly endorsed all that he had said with reference to the good management he spoke of. He might tell them that, so dissatisfied was he and other shareholders with the reckless spending of money, that he consulted a large firm of solicitors, and asked their advice as to what course he could pursue to bring the directors to book, and in some way stop the career they had embarked upon. Their advice was that he should apply for an injunction restraining them, and fix upon one particular act to specify. The most flagrant thing at the moment seemed the payment of close upon £500 a year for offices, clerks, &c. Hearing that the company was about to have a meeting, he thought he would wait and hear whether there was any possibility of some reduction; but, alas, no reduction whatever took place. The chairman had said that he had 10,000 proxies; they all knew that that was the most objectionable form of voting in the city of London, because people who voted by proxy knew nothing of the affairs of the company. The chairman had spoken of the way in which they had conducted the affairs of the company up to the present stage. They knew that in many other companies there were directors who had had the common sense to see that when the concern was doing nothing at all, it was the proper and just course to wind up. There was no doubt that this company ought to have been wound up two years ago; then the directors would have shown some foresight and business knowledge, which at present he could hardly see that they had. Therefore he should vote, and his co-partners with him, for a change in the direction, because they had no further confidence in the present board.

Mr. T. B. Williams asked if the chairman could foreshadow the approximate profits in some way or other. He had stated that there were some profits likely to ensue, and he (Mr. Williams) would like to know what they were.

The Chairman: There are objections to that. We have rivals, and would rather not go into the matter. The chairman then moved the adoption of the report of the directors and the accounts, consideration of which was postponed from the meeting in December last.

Mr. Cater seconded.

A Shareholder asked if it was necessary that there should be six directors in England for a business in the colonies. It might be that the directors were original shareholders, but if they allowed their fees to accumulate they would get back all the money they had invested. Nothing that had been said could justify sending out Sir Julius Vogel with £10 a day; and although it had been very nicely smoothed over by the chairman, he had not upset a single word which had been said by the committee.

Mr. Kisch spoke in justification of the committee's report. The committee conducted their enquiry wholly without any animus towards the directors. The chairman had suggested that the committee had not carried out their mandate, but that he denied; they were appointed to confer with the board and report to the shareholders, not to the board. He had been reproached for not discussing matters with the board; but as regarded the future, they were in the hands of the board; they did not know more than what they chose to tell them of what they were doing or contemplating; and as to the past they felt that they did not want to occupy their time; whenever they had any doubts as to facts they consulted the secretary. No doubt the directors had received a large number of proxies, and they did not wish to enter into a contest with them in that respect. But the list of proxies, very large as was the number of votes it carried, was not quite so significant as might possibly be inferred from the bare statement. For instance, they were aware that the vendors received between them 6,000 shares, credited as fully paid-up; he need scarcely tell them that the whole of those votes were included, amongst them being a large number which it was intented to surrender. The directors told them that Sir Julius Vogel held a large number of shares—in addition, he supposed, to the vendor's shares. Whether that were so or not, they were not in his name; there was not a single share upon which he could be sued for his calls. The board said the committee had formed erroneous conclusions on several points; he wished to show them that in no material point had their conclusions been successfully impugned. They said it was easy to be wise after the event, and that they or any others in their place would have done no better. That might be said by anyone who committed an error; what they expected of a board of directors was that they should have a little more calmness than the general public, and not be led away quite so hastily. The most they (the committee) said of Sir Julius Vogel's mission was that it was unwise and extravagant. They were more or less justified in the first instance, perhaps, in sending an agent out, not necessarily Sir Julius Vogel, but someone in whom they had confidence, and with reason. In the course of the report the committee said that the engagement with the New Zealand Company was the only achievement of Sir Julius Vogel's mission. In reply to that the board said that if the committee held that view, they knew very little about it; but they did not tell them what else he did achieve. The fact was he did probably obtain one or two lighting contracts, and there was no doubt that he attempted to do something in return for the very large payment he was receiving. Then with regard to the New Zealand Company, the committee said that Sir Julius Vogel took shares for this company in what was really no company at all. The directors replied that they ought not to say that, for "it is difficult to see how this can be considered in any sense other than that of the actual facts, that the company was *being formed* by Sir Julius Vogel on the basis alluded to." In Sir Julius Vogel's report it was stated quite distinctly that the shares were not being issued at the time, but he had such confidence that he put some of his own money into it; and the directors referred to that fact as showing his *bona fides* in the matter. They knew probably what Sir Julius Vogel received directly from this company, but what he received in any other way it was difficult to say. Would they believe it, this having been made a point of, that the sum he put into that New Zealand company was £200! (Laughter.) The board told them they were deceived, that they were without any information or suspicion of the liability which Sir Julius Vogel had incurred. No doubt they were in the first instance; the first information was by telegram, which did not disclose the exact facts. But when Sir Julius Vogel returned home he told them all about it; they knew all about it in good time—not in time, perhaps, to repudiate as against third parties, and the committee had not suggested that they should have done so. What they suggested was that they might have held Sir Julius liable for the large amount for which they had been let in. There was no evidence that they ever attempted to do so, and they said that they could not, that it would have been necessary to prove bad faith, and considering Sir Julius's own subscription to the company that could not have been done. There was no evidence that they took advice or thought of doing so. The committee said if they had done so Sir Julius Vogel would not have been a very large loser by this company. He told them in his report that this liability, which ultimately proved so serious a matter, would practically be nothing at all, that practically they would never be called upon to pay it. How far that was the fact they already knew. One simple error the committee had fallen into, in stating that no legal advice was taken. The directors replied that no less than three legal opinions were taken. They of course imagined that if an opinion had been taken it would in the natural course of things have been done through the solicitor; they had questioned him, and he said "No;" and they spoke to the secretary, and he did not tell them. It seemed that a lawyer in Australia, one in New Zealand, and a third in England, were consulted, but the company's legal adviser was not consulted. The directors stated, with respect to the accumulator option, that the purchase was carried through after long discussion. The company's solicitor was present, and would probably feel called upon to speak upon that point, for the whole of that section of the directors' reply was more or less an attack upon him in his professional capacity. Nothing that the committee had stated was denied, except the general statement that the matter was rushed through without circumspection. It was rushed through at one meeting. The only thing the committee stated was that, unwise as the option of purchase was, it probably would have been still more unwise to have completed the purchase. The directors had complained that the committee made a slight insinuation against Sir Julius Vogel, that he had some other interest in pressing this matter on the board. Considering how urgently he pressed it upon them, they must have been very deficient in worldly wisdom if they did not suspect that he had some other interest. The fact was that Sir Julius Vogel was to receive from the vendors a large commission on the price at which the patents were sold to them, 10 per cent. He might say here that the committee had never charged the board with any want of honesty. The chairman had distinctly stated that the board had throughout acted honestly, and so far the committee agree completely with them; but they said that throughout these matters the board had shown some incapacity and mismanagement, and he thought as much as that had been admitted. He was perfectly content to accept the statement of the board as to their true and deliberate intention that they did not intend to claim any portion of the undrawn fees until the position of the company became very different to what it is; but this suspense account would go on rolling up from the 30th June last at the rate of £1,000 a year, and what would it amount to by the time the company was in a position to pay a dividend? They did not wish to see, should the company ever be brought to a moderate success, an accumulated debt against them of £8,000 or £10,000. He was very glad to hear that the directors thought the prospects were fairer, but he did not know that they could feel confidence that the gentlemen who had managed the affairs of the company as these had managed them in the past by their own admission, would act very much more wisely in the future.

Mr. Ince, the original solicitor of the company, said the history of the accumulator option was to a certain extent a simple one, as far as this company was concerned. At the board meeting Sir J. Vogel came into the room and told the directors that he had secured the option to purchase the Sellon-Volckmar accumulators up to 4 o'clock that day for £5,000. He was requested to attend at 4 o'clock with Mr. Trender, the solicitor to the vendor company, and himself (Mr. Ince), to see the solicitors of the Sellon-Volckmar Company, to see if an agreement could be entered into. Practically his (Mr. Ince's) instructions at that time were to part with the £5,000 almost on any terms to secure the option, because the board believed that they were very valuable patents to secure. The directors in their remarks had made one mistake. They had coupled with his name not only the suggestion that he was an experienced man of business, but also the fact that he was more or less an electrician. In acting in the matter of the option he was in no way acting as an electrician; he believed at the time these arrangements were proposed to the board that those patents were worth very little. If put to him as an electrician whether it was a wise thing to do he would have replied, "Most decidedly not." But he simply went as solicitor to the company to carry out the instructions of the board, and not to bring in his private and technical knowledge as an electrician for their benefit. They had their own electricians on the board, and others as able to judge of the value of the Sellon-Volckmar patents as he was. His instructions were practically to part with the £5,000 if Sir J. Vogel and Mr. Trender were satisfied, no matter whether they got it back again or not. The agreement was not entered into then and there, but left for subsequent settlement, notwithstanding that there was a clause in the draft agreement which provided that the payment for the option should be made on the terms that the agreement should be entered into. This clause was sufficiently clear to have entitled them to recover the £5,000, and his (Mr. Ince's) view of that clause was agreed to by Mr. A. L. Smith, his counsel, now Mr. Justice Smith. He did not believe that the directors knew more than he did of the existence of a memorandum showing that negociations had taken place between Sir Julius Vogel and Sir Daniel Cooper, one of the directors of the Sellon-Volckmar Company. Neither was it known to the directors nor to him that Sir Julius Vogel had stipulated for a commission of 10 per cent. on any amount this company might pay. If he had known for a moment that such a stipulation had been made, he would have told Sir J. Vogel that he could be no party to the payment of that money, and he would have told Sir Julius Vogel in language that was very plain what he thought of him. (Applause, and "Everybody knows what he is.") The board states that they were under the belief that the purchase they were arranging was an option; he believed that was perfectly true at the time. The directors believed, as he did, that they would be able to recover the money, and so they would have, had all the circumstances been known to them at the time, and if they had been as they believed them to be, and not as Sir J. Vogel knew them to be. He believed in that matter the directors were as much taken in by Sir J. Vogel as he was. These remarks did not touch upon the general wisdom of the board in entering into such an agreement. It was not an arrangement he would have advised clients of his to enter into, or that he would have entered into himself; but in that matter he was left no option but simply to carry out the instructions given him.

Mr. Frederick Roberts asked if Sir J. Vogel could not be sued for that £5,000.

Mr. McKay wished to have a clear statement from the Chair as to Sir J. Vogel's position. How many shares did he take in the first instance, and what had he got out of the company?

A Shareholder: Nobody knows. (Laughter.)

Mr. Martin Jaffray moved the payment of a sum of £100 to the committee in remuneration of the services they had rendered.

Mr. Wainwright seconded.

A lengthy discussion followed, in which Mr. P. Falk, a director, Mr. Ince, Mr. Roberts, Mr. Stephens, Mr. Kisch, Mr. Pearson, Mr. Robarts, and Mr. Van Tromp took part, after which

The Chairman said there had been an inclination on the part of everyone to mix up the early mistakes which the board had made with the present, and assume that those mistakes were going on as before. He believed their new director, Mr. Van Tromp, would tell them that they were now, and had been for nearly 18 months, perfectly aware of the mistakes they had made, and had entirely altered their policy, and were doing their utmost to bring down the expenditure. He was perfectly conscious that so far as the general body of sentiment expressed to-day was concerned, the feeling was very much against their continuance in office. If they resigned, it was evident somebody must take their places. No doubt there were plenty of gentlemen perfectly willing, and to a certain extent competent to do so, but they would not have the advantage of the long previous knowledge and intimate connection with the colonies which some of the present directors possessed. Besides, they must look to the great body of shareholders, who had shown their confidence in them, and therefore he would say frankly that they were not disposed to resign their seats. With regard to the directors' fees, at the present moment they were not disposed to give way before a pressure of the kind which had been placed upon them. Answering other questions, he said Sir Julius Vogel took 250 shares himself, in addition to the 1,542 he received as one of the vendors; these latter shares he gave up.

Mr. Jackmann: Could the secretary tell us how many golden sovereigns this man has had?

Mr. Duncan replied that he thought Sir Julius Vogel had received £4,200 altogether.

Mr. T. B. Williams suggested that two or three of the directors should resign, and a little new blood be placed upon the board.

The motion for the adoption of the directors' report was now put, and was rejected by the votes in the room.

The Chairman, however, said he should use the proxies the board had received, with which the report was carried by a large majority.

A poll was demanded, and was arranged to be taken on Monday next, between the hours of eleven and two.

The motion for remunerating the committee was then put and carried, and the meeting terminated.

The committee has, since the meeting reported above, issued a circular addressed to the shareholders, describing the action of the directors in regard to the matter of the suspense account formed by undrawn fees, and urging an expression of opinion at the poll on Monday antagonistic to such action.

South-Eastern Brush Electric Light and Power Company, Limited.

In compliance with a requisition the directors have called a meeting for the 13th instant, to consider resolutions for voluntarily winding-up the company. Commenting upon the action of a section ofthe shareholders, the directors write:—

"In forwarding the annexed notice of an Extraordinary General Meeting, called in compliance with a requisition signed by certain shareholders at the solicitation of Mr. W. Hewett, jun., and Mr. R. Braithwaite, the directors beg you to clearly understand that they are as strongly opposed as ever to the *immediate* liquidation of the company, as they believe the adoption of such a course would be most prejudicial to the shareholders.

"The directors repeat, and are ready to fulfil, the pledge given by them in their circular of the 21st ultimo, viz.:—'To use their best endeavours to make terms with the Anglo-American Brush Corporation; to try to sell the Colchester Installation as a going concern; or, with the consent of the Board of Trade, to remove the plant elsewhere; and then, at an early date, to wind up the company voluntarily.'

"It will be for the shareholders to determine whether this reasonable course shall be adopted, or whether they will allow the company to be completely wrecked, as it undoubtedly will be if the proposed resolutions are carried."

Under the date of March 9th, Mr. W. Hewett, jun., and Mr. R. Braithwaite, have written as follows to the shareholders:—

"The shareholders have now had before them the report of the committee of inquiry, and the reply of the directors thereto.

"At the general meeting in December, the directors strongly advocated the continuance of the business of the company, on the ground that it was upon the very threshold of success, and they as strongly opposed the appointment of the committee of inquiry.

"It now seems that the directors reconsidered the position of the company by the light of the report of the committee; they no longer oppose the winding up, and practically the only matter now for the decision of the shareholders is whether the liquidation shall forthwith take place, as recommended by the committee, or whether it is to be indefinitely delayed at the pleasure of the directors while they *endeavour* to make terms with the Anglo-American Brush Corporation, and *try* to sell the Colchester installation or remove the plant elsewhere.

"It must be well known by the directors, that making any terms with the Anglo-American Brush Corporation which will be beneficial to the shareholders of this company is quite beyond reasonable expectation. Selling the Colchester installation as a going concern, assumes the possibility of finding purchasers for a thing which the working shows will entail a heavy annual loss to the purchasers, even if the installation were given away.

"The suggested removal of the plant elsewhere, can be done as well after the appointment of liquidators as before, unless, indeed, the directors contemplate further expense for the maintenance of the plant when removed.

"We would now ask every shareholder, however small his holding, to pay up his call before the meeting on the 13th instant, as otherwise he cannot vote thereat, and we confidently ask that the enclosed proxy may be signed and returned without delay. It will supersede any that may, under a mistaken impression, have been sent to the directors.

"That a voluntary liquidation forthwith is absolutely necessary, if further calls are to be avoided, we feel quite convinced; and we think that you will agree with us that if liquidators are appointed, they should not be directors or their nominees, but independent shareholders. We have taken a great deal of trouble in this matter, and it is now for the shareholders to determine whether they will abide by and support the recommendations of the committee, or whether they will give the directors a further opportunity of continuing to expend the shareholders' money in a manner which we consider has been both reckless and improvident."

Brazilian Submarine Telegraph Company, Limited.—The directors of this company have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income tax, for the quarter ended 31st December, 1884, and payable on the 25th inst. The books of the company will be closed from the 18th to 24th inst., both days inclusive.

Consolidated Telephone Construction and Maintenance Company, Limited.—A petition is to be heard before Mr. Justice Chitty to-day, the 14th inst., for the confirmation of the reduction of the capital of this company from £300,000 to £243,787.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company. Limited. The estimated receipts for the half-month ended the 28th February, are £2,403, as compared with £2,517 in the corresponding period of 1884.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending February 28th were £3,890.

NEW PATENTS—1885.

2747. "Construction of storage or secondary batteries, or electric accumulators." W. Symons. Dated March 2.

2765. "Electrical accumulators or secondary batteries." W. R. Lake. (Communicated by A. Marchenay.) Dated March 2.

2776. "Electric motors." W. H. Allen, G. Kapp, R. Wright. Dated March 2.

2782. "Construction of ring armatures for dynamo-electric machines." G. C. Fricker, W. C. Mountain. Dated March 3.

2783. "Regulating the feed of carbons in electric arc lamps." W. C. Mountain. Dated March 3.

2795. "Secondary batteries." H. J. Allison. (Communicated by P. Benjamin.) Dated March 3.

2796. "Dynamo-electric machines, magneto-electric machines, &c." W. H. Allen, G. Kapp, R. Wright. Dated March 2.

2812. "Apparatus for electrical illumination of railway trains." R. H. Woodley. Dated March 3.

2818. "Electrical conductors." C. A. Day. (Communicated by H. F. Campbell.) Dated March 3. (*Complete.*)

2833. "Application of electro-magnetism to arm-chairs, seats, carpets, &c., to produce a magnetic bath or medium." W. L. Wise. (Communicated by G. Edard.) Dated March 3.

2834. "Magneto-electric appliances to be worn chiefly for preventing sea-sickness." W. L. Wise. (Communicated by G. Edard.) Dated March 3.

2852. "Fuse piece for automatic breaking of electric circuits." J. L. Fuller. Dated March 4.

2861. "Determining pressures and work done by the thermo-electric properties of metals." A. W. Anstruther. Dated March 4.

2874. "Incandescent electrical light with automatically revolving carbons." F. Spurny, J. Wejtraba. Dated March 4.

2878. "Electric rotary brushes." W. S. Frost, J. L. Merigot, G. C. C. Fein. Dated March 4.

2893. "Telephonic transmitters." C. D. Abel. (Communicated by Société Generale de Telephones.) Dated March 4.

2896. "Dynamo-electric horse clipper." C. de Salazar. Dated March 5.

2897. "Mechanical self-acting revolving magneto-electric brush for cleaning, strengthening, and giving brilliancy to the hair." C. de Salazar. Dated March 5.

2911. "Compasses for ship or other use." H. C. Williams. Dated March 5.

2924. "Automatic electric coupler." J. S. Raworth. Dated March 5.

2936. "Holders for electric incandescent lamps." S. Z. de Ferranti. Dated March 5.

2960. "Appliances for electrically controlling and regulating the speed of motors employed for driving dynamo-electric machines." C. J. Bosanquet, W. A. Tomlinson. Dated March 6. (*Complete.*)

2966. "Foot step for telegraph posts." A. E. Gilbert. Dated March 6.

2970. "Insulated electric conductor for underground and other purposes." E. W. Lancaster. Dated March 6.

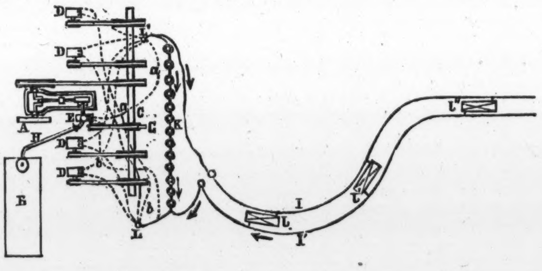
2985. "Electric arc regulators." J. G. Slatter. Dated March 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

123. "A method of and apparatus for measuring and registering electric currents." J. TAVENER. Dated January 1. 6d. Consists of a tube terminating in bulbs, similar in principle to a differential air thermometer, but having platinum wire or other substance, of sufficient resistance to generate heat on the passage of a current of electricity through it, inserted through each bulb; the whole being partly filled with a fluid, such as mercury, and hermetically sealed. This tube with bulbs, &c., rests on a support, at a point intermediate between the bulbs, and may be regarded as a hollow lever, whose support is its fulcrum, on which it turns, and whose equilibrium can be disturbed by the displacement of the contained fluid. The whole is so metallically connected up and arranged, that on inserting it in a circuit, the electric current will first traverse one bulb, heating the resistance, expanding the air, driving the fluid to the other bulb, making that heaviest, turning the lever, breaking connection with the one bulb, making connection with the other, heating the resistance contained in that, and in a similar manner again turning the lever.

1077. "Improvements in and relating to telephone transmitters." G. L. ANDERS. Dated January 9. 6d. The inventor provides a cup-shaped piece of engine coke; to this is attached a loose contact piece of good conducting material, as in the well-known "Hughes" microphone, such as platinum or carbon.

1197. "Improvements in and relating to the employment of electric currents, and apparatus for regulating or controlling the same." W. R. LAKE. (Communicated from abroad by N. de Kabath, of Paris.) Dated January 10. 6d. The inventor arranges at a central station, as shown in the fig., a steam engine or motor, A, and a steam generator, B. The main shaft, C, from which the dynamo-electric machines, D, are driven, carries a pulley, G, which drives a corresponding pulley, F, mounted upon the shaft of the steam regulator, E. H indicates the steam pipe leading from the boiler to the engine. I, I^1, indicate the rails upon which the vehicles, J, J^1, J^{11}, run, K, indicates accumulators and L, L^1, the principal binding posts with which all the machines are connected; *a*, *b*, indicate the electrical connections between the said binding posts and the steam regulator, E. The apparatus is operated in the following manner, that is to say, all the communications being established the dynamo machines are set in motion and produce a strong current of electricity, which passes to the accumulators, K, in the direction of the arrow. When these accumulators are sufficiently charged, they offer to the current coming from the said machines a contrary electromotive force, and completely stop the current passing in the direction of the arrow. At this time the steam regulator commences to operate. This regulator is constructed in such a manner that when the current has a sufficient potential, a current passes through the wires, *a* and *b*, which causes suitable mechanism to act upon the steam regulator, E, in order to control the admission of steam and decrease the speed of the machines. If, however, a large quantity of electricity is required at J, the quantity of electricity passing through the conductors, *a* and *b*, to the regulating apparatus is diminished, thereby allowing the admission of an increased quantity of steam and consequently an increase in the speed of the machines producing a corresponding increase in the electromotive force of the current. If at any moment there is a requirement for a stronger current than that generated by the dynamo-electric machines the necessary current is supplied by the accumulators which are charged so as to cause a current to pass in an opposite direction to that shown by the arrow at K. The opening and closing of the steam valve is effected by means of a belt passing over the pulleys, G and F. The electric current which passes through the mechanism in the said valve determines whether the said valve shall open or close.



1273. "Improvements in the manufacture of electrodes for primary electric batteries." T. ROWAN. Dated January 11. 4d. The inventor employs zinc in a suitable state of division and forms it into plates, or causes the divided zinc in the form of paste or otherwise to adhere to a framework of zinc of any desired configuration; the zinc may be amalgamated when required, either before or after its formation into electrodes. In some cases he employs spongy iron forming it into an electrode as above described, or oxide of iron may be similarly employed. He also forms an electrode in a similar manner by using black oxide of copper or copper precipitate, the framework employed being either of copper or lead coated with copper, and the copper precipitate may be precipitated either chemically or electrically. Carbon may also be employed for the framework of the electrode, on which framework are electrically deposited silver, copper, aluminium, or other suitable metal.

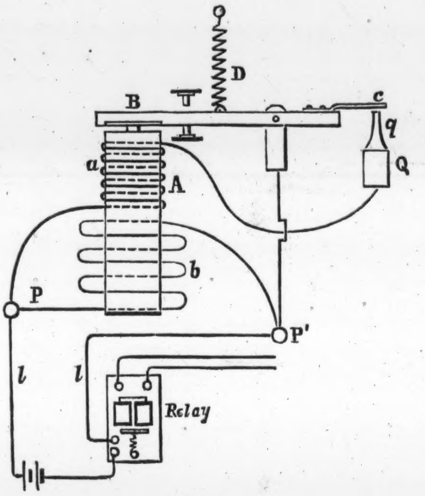
5157. "Improvements in electric jewellery and ornaments." A. M. CLARK. (Communicated from abroad by G. Trouvé, of Paris.) Dated March 19. 8d. The distinguishing feature consists in intercepting the luminous rays which are emitted by a small incandescent electric lamp by means of lenses either faceted or not, or preferably by means of coloured artificial gems or stones.

7512. "Improvements relating to apparatus for establishing and maintaining electrical communication between fixed and movable parts of electric circuits, chiefly designed for use on railways." W. R. LAKE. (Communicated from abroad by N. de Kabath, of Paris.) Dated January 10. 6d. Relates to conductors and contact brushes for maintaining electrical connection between two parts of a circuit, one of which is fixed and the other movable.

10951. "Improvements in electric lamps." G. PITT. (Communicated from abroad by C. Beck, of Paris.) Dated August 5. 6d. Consists in utilising the electric spark in a medium composed of a gaseous mixture of nitrogen and mercurial vapour in sufficient quantity to easily hold in suspension fine carbonaceous particles which are also present. The spark produced by a suitable induction machine between two electrodes in this medium encounters the carbonaceous particles which, in consequence of the high tension of the gas and their own minute dimensions, are drawn in a rapid current which causes them to pass rapidly and repeatedly into the spark, so that at the end of some seconds the globe in the interior of which the phenomenon occurs is full of a luminous and incandescent atmosphere. Each carbonaceous particle becomes white, and from its small dimensions, and as carbon has a very high radiating power, the lamp gives a light sensibly superior to that of gas. Besides, in consequence of the rapidity of the currents the light may be regarded as constant; finally, the carbon cannot be consumed, because the medium in which it is placed is destitute of oxygen, and contains azote only, which is unsuited for combustion. The mercurial vapours are intended to increase the density and the better to maintain the spark.

12993. "Improvements in electric cables." T. G. TURNER. Dated September 30. 6d. The objects of the invention are, first, to so construct the armour that it may be opened at any point, without rupture of the metal of which it is composed, to afford access to any one or more of the conductors of the cable, and again closed and sealed; second, to so arrange the individual wires or conductors of the cable with relation to an indicator, and to each other, that any one of said conductors may be readily found; third, to so arrange the conductors and indicator with relation to the joint or seam of the armour that the indicator and each of said conductors will pass said seam once in a given distance; fourth, to establish contact between the core and armour to lessen the effect of induced current; also to provide a core which will yield slightly upon the contraction of the surrounding conductors, also to provide means by which the interstices between the conductors may be filled with a material which will repel moisture, and, finally, minor objects relating to the laying or use of a cable.

13281. "Improvement in electro-magnetic apparatus, especially applicable to telegraphic instruments." H. J. HADDAN. (Communicated from abroad by C. Cummings, of America.) Dated October 7. 6d. This invention relates to an improvement in electro-magnetic apparatus designed for use in normally closed circuits, such, for instance, as telegraph sounders, Morse registers, relays and other instruments which are in active use at intervals and meanwhile lie idle with the battery current traversing their coils. The fig. illustrates the principle of the apparatus. A indicates the electro magnet. B its armature, C the armature lever provided with front and back stops, as usual, and D is the retracting spring for holding the armature against the back stop. Upon each of the cores, A, of the magnet are arranged two coils, one, indicated by the letter *a*, being a coil of low resistance arranged directly upon the core, while the other, *b*, is, a coil of much higher resistance surrounding the coil *a*. The similar coils on the two cores are connected together in the usual manner, and both have one end connected to a terminal, P, the coils, *b*, having their opposite ends connected to a terminal, P^1, and the coils, *a*, have their opposite terminals connected with a contact, Q, provided at its upper end with an adjustable contact point, *q*, arranged in the path of a contact spring, *c*, attached to the rear end of the armature lever. The armature lever must be electrically connected with the terminal P^1. Supposing the sounder to be used with a local battery having a resistance of one unit, including the resistance of the conductor connecting it with the sounder, the coils, *a*, of low resistance should have about the same resistance, namely, one unit. The coils, *b*, have a resistance about thirty times that of the coils, *a*. It will be seen from the fig. that when the armature is attracted by the magnet, there is between the contact spring, *c*, and contact point, *q*, a break in the circuit through the coils, *a*, of low resistance, but these circuit closing and breaking devices do not affect the circuit through the coils of high resistance, except that by their action in closing circuit the current will be shunted or short circuited from said coils of high resistance in a great measure, that is, the current will be divided between the two sets of coils in inverse proportion to their resistances. In other respects the coils of high resistance are worked precisely like the coils of an ordinary sounder. The action and purpose of the circuit breaking devices will be understood by considering the successive positions of the different parts of the apparatus while the sounder is operating in response to the makes and breaks of circuit during the transmission of a message. As represented in the fig., the sounder is supposed to be connected in a local battery circuit by wires, *l*, *l*, and the local circuit closed by the usual relay as shown at R. The current is now passing only through the coils, *b*, of high resistance, which sufficiently magnetise the cores to cause them to hold the armature lever upon its front stop against the force of the retracting spring, but these coils would not sufficiently magnetise said cores to cause them to attract the armature promptly if the lever were against its back. When the relay breaks the local circuit the armature is drawn away from the magnet poles by the retracting spring, and the contact spring, *c*, strikes the contact point, *q*, thus closing the break through the coils, *a*, of low resistance. No current passes until the relay closes the local circuit, at which time nearly the whole current from the battery passes through the said coils, but only for an instant, as the circuit through the coils of low resistance is again broken when the cores under the vigorous action of these coils promptly attract the armature and cause the lever to strike its front stop while throwing the spring, *c*, up out of contact with the point, *q*. The current now goes only through the coils of high resistance which are sufficient to hold the armature down as before explained. These coils are of such great resistance that they greatly retard the consumption of material in the local battery and a great saving is thus effected as will be understood.



CORRESPONDENCE.

Speaking Condensers and Wimhurst's Machine.

The review of Mr. Giltay's paper in *Archives Neerlandaises* was all too short, and no opinion expressed as to his explanation of the causes of their speaking being right or wrong. No one writes to you (on the invitation to enter the telephone wrangle) their experience of condensers, as might be expected; but that even small condensers of 8 leaves speak very well is true, and many must have used them. Even a microphone can be made to speak. These two, the condenser and the microphone speakers, should teach us something which we lack about electrical talking, and correspondents (if they were not supposed to be entering a telephone wrangle) might tell us of them. Mr. Shelford Bidwell exhibited a speaking microphone some time back at the Telegraph Engineers' meeting. As to telephones the great case never went to the Lords to be threshed out; the Globe Company being subsidised by, or incorporated with, the U. T. C., their Hunnings and other patents bought, the public have not yet heard all the arguments which the Globe appear to have used with success.

Wimhurst machines.—There are great statements advertised of the performances of these "9-inch" spark from 16-inch plate machine. Surely this is a statement which will not bear sifting! Some authentic statement of the performance of ordinary machines would be acceptable to your readers.

I must apologise for asking you to refer to so many things, but you have the threads of all these things in your hands and can call up each branch of these questions at will.

H. G. Yatman.

March 7th, 1885.

Ball's Dynamo.

As there has lately been a considerable amount of discussion in regard to this unfortunate dynamo, perhaps you will allow me to record some observations and comparisons I made at the late Fisheries Exhibition, where one of these so-called unipolar dynamos was in operation. I was not the least surprised to find that the machine would *work*, because to my mind the construction is, to a certain extent, in accordance with well known laws; each armature rotating as it does in a simple magnetic field. But, when I saw two Gramme armatures in lieu of one, I naturally expected an increased out-put as compared with a machine having only one Gramme armature of the same dimensions. I need only say that I was greatly disappointed, for my expectations soon fell to the ground.

In the first place, I compared Ball's machine with one of the special Gramme dynamos which Messrs. Emmerson, Murgatroyd & Co. had constructed for me. Each of these Grammes gave 300 volts and 14 ampères at 1,350 revolutions per minute, this being the E.M.F. and current I used to work eight of my arc lights in series. These Grammes were each driven by 4 inch light link belts.

Ball's machine was, I believe, working six of his arc lights in series with a 10 ampère current, each lamp I presume requiring, as is usual with that current, an E.M.F. of 50 volts. In other words the output of the Gramme was 4,200 watts as against 3,000 with the Ball machine. The next point I noticed was that each armature in Ball's dynamo was, or appeared to be, somewhat larger than the armature in my Gramme; that each armature was certainly wound with much finer wire, and appeared to contain a greater number of sections, obviously to raise the E.M.F.

I believe the armatures in Ball's machine were coupled in series, and the dynamo was driven, if I recollect rightly, at about 1,500 revolutions by two 2 inch belts—one on each side of the machine—which of course amounts to the same thing as one 4 inch belt. On placing my hands near the armatures they appeared to be warmer than either of the bobbins in my Grammes.

After carefully watching the performance of this machine, I came to the following conclusions :—

1st. That the Ball machine was a very expensive one to construct.

2nd. That whatever price the Ball machine could be made at, a more efficient Gramme could be made at about half this price.

3rd. That the Ball machine was defective in construction both mechanically and electrically—mechanically because it is far more complicated and liable to get out of order than is necessary, and electrically because the magnetic field does not enable the lines of force to pass to the armature as it would do if another opposite pole were added as in other machines.

In the ELECTRICAL REVIEW of February 28th you publish a letter from Prof. Silvanus Thompson, containing some comments he made on Ball's machine at the Philadelphia Conference, and in a note in the same issue you say that Prof. Thompson evidently dislikes the subject of this machine. I can only say that I quite agree with Prof. Thompson's views in regard to this dynamo.

My observations do not enable me to agree with you when you say, "With a given amount of wire spread over two armatures instead of one, the pole pieces are brought proportionately closer to the iron rings of the armatures, and double the cooling surface is presented by the wire," for, as I have already stated, each bobbin in Ball's machine at the Fisheries contained, or appeared to contain, more wire than the bobbin of the

Gramme I was using there, and which gave better results than both bobbins combined in Ball's machine.

Charles Lever.

Bowdon, Cheshire, *March 6th.*

[We are pleased that a gentleman of Mr. Lever's reputation should have taken upon himself to enter into a discussion on this matter. His letter, however, would have been of more value if it had contained actual facts instead of being entirely compiled of suppositions. Whilst ourselves viewing with no particular favour the form into which this dynamo has accidentally resolved itself, we cannot blind ourselves to the fact that it is a remarkably efficient one. The following extract from the New York *Electrical Engineer* may be interesting to our correspondent, and probably Mr. Raymond may be willing to show the error into which Mr. Lever has fallen respecting the cost of the machine.—EDS. ELEC. REV.]

COMPARISON OF BALL 20-LIGHT AND BRUSH 16-LIGHT.*

	Ball.	Brush.
Copper wire per lamp, on armature	2½ lbs.	7 lbs.
„ „ „ on magnets	6 „	54·2 „
„ „ „ on machine	8½ „	61·2 „
Total weight of machine per lamp	39 „	147·0 „
„ „ (about) per horse power	65 „	147·0 „
„ „ copper „ „	14·1 „	61·0 „
„ „ of copper on machine	·170 „	979 „
„ „ of machine	780 „	2,352 „
Periphery speed of armatures	3,800 ft.	3,900 ft.

WEIGHT OF PRINCIPAL ARC-LIGHT DYNAMOS.

	"Unipolar."	Thomson-Houston.	Brush.	Weston.
5-light machine	300 lbs.	1,000 lbs.	1,150 lbs.	450 lbs.
10 „ „	520 „	2,000 „	1,500 „	1,200 „
12 „ „	...	2,200 „	...	...
16 „ „	...	3,000 „	2,352 „	2,000 „
20 „ „	780 „	3,300 „	...	2,400 „
35 „ „	1,360 „	...	...	...

WEIGHT OF INCANDESCENT DYNAMOS.

	"Unipolar."	Edison.	Weston and Exciter.	Brush Victoria.
45 lamps	300 lbs.	...	...	...
60 „	500 „	3,000 lbs.	2,575 lbs.	...
80 „	500 „	...	...	...
100 „	750 „	4,500 „	3,775 „	1,350 lbs.
125 „	750 „	...	...	1,350 „
150 „	1,000 „	...	...	1,600 „
180 „	1,000 „	6,000 „	...	1,600 „

NOTE.—The total weight of machines other than the "Ball," are in the main taken from the catalogues of the various companies.

Telegraphing from Moving Railway Trains.

In reference to the account published in your last week's issue of a method of telegraphing from moving railway trains, designated as "newly invented," by Mr. Phelps, may I point out that this system of communicating with moving trains by means of electrical induction, almost exactly as described, was invented by me as far back as 1881, and actually tried electrically far enough to prove its complete feasibility.

My object was chiefly to provide an efficient means of fog signalling, by enabling the signalman to communicate directly with the drivers or guards of moving trains.

I proposed to run a wire along the permanent way, parallel with the rails, and to wind a coil of wire round the engine or carriage to be communicated with in such way as to get as long a length of wire parallel to, and as near to the line-wire, as possible, so as to be well exposed to the inductive action thereof, exactly as is now done. I then proposed to place in the signal boxes a battery, signalling-key, and rapid "make and break," or "buzzer," as your account calls it, and to thereby signal to the train, using a telephone on local circuit with the car-coil as a receiver. By using an ordinary carbon-transmitter on direct circuit with the line wire, I also arranged, and found it quite practicable to speak verbally to the train, so as to be heard distinctly in the telephone or telephones in the "car-coil" circuit.

This design was embodied in a paper which, in the year 1881, I laid before Mr. Morgan, then and now managing director of the United Telephone Company. Want of time and opportunity alone has prevented it being put into practice. It was also tried practically at that time, using wire-coils, properly proportioned, in length, resistance, and distance apart, to the conditions that would be obtained in practice. The trial was certainly not made on an actual moving engine; but the fact of the coils remaining stationary instead of moving, could, of course, make no possible difference, since the speed of the fastest engine is practically nil, compared to the rate at which the contiguous particles of a line-wire are affected by an electric current, *i.e.*, the "speed" of the current.

I have abandoned this method of working, however, in favour of a very much more simple and effective way, to which I was led while experimenting thereon, and which system I hope shortly to have an opportunity of putting into practice.

The possibility of communicating with moving trains by means of electrical induction, was also suggested by Mr. Willoughby Smith, in a paper read before the Society of Telegraph Engineers last year, so that the principle can certainly not now be called new, the details alone being patentable.

In the method of working described last week, too, I am afraid that a great difficulty would arise in practice, from the necessity for employing so strong a current. Every electrician knows that to maintain a current of one and a half ampères from every signal-box, over line-wires having considerable resistance, would not be easy, to say the very least of it. It means dynamos or special batteries with the necessary accompaniment of special men to look after them.

By the improved means mentioned above, however, I have already succeeded in producing results similar to those described, across a space of six inches, by induction from an ordinary No. 8 line-wire, using a current of only ¼ ampère, *i.e.*, such as can easily be produced by the ordinary Daniell batteries used in railway work. I cannot at present give details of this method, as so doing would invalidate a patent, but hope shortly to be in a position to do so.

A. C. Brown.

11, Old Broad Street, London,
10*th March*, 1885.

On the evening of November 8th, 1883, I contributed to the "Society of Telegraph Engineers and Electricians" a paper on "Volta-Electric Induction." The paper, and the discussion which followed, are fully given in the journal of that society, No. 50, Vol. 12, from which I make the following extract:—

"Telegraph engineers and electricians have done much towards accomplishing the successful working of our present railway system, but still there is much scope for improvements in the signalling arrangements. In foggy weather the system now adopted is comparatively useless, and recourse has to be had at such times to the dangerous and somewhat clumsy method of signalling by means of detonating charges placed upon the rails. Now it has occurred to me that volta induction might be employed with advantage in various ways for signalling purposes. For example, one or more wire spirals could be fixed between the rails at any convenient distance from the signalling station, so that when necessary intermittent currents could be sent through the spirals; and another spiral could be placed beneath the engine or guard's van, and connected to one or more telephones placed near those in charge of the train. Then, as the train passed over the fixed spiral, the sound given out by the transmitter would be loudly reproduced by the telephone, and indicate by its character the signal intended. One of my experiments in this direction will perhaps better illustrate my meaning. The large spiral was connected in circuit with 12 Leclanché cells, and the two make and break transmitters before described. They were so connected that either transmitter could be switched into circuit when required, and this I considered the signalling station. This small spiral was so arranged that it passed in front of the large one at the distance of eight inches, and at a speed of 28 miles per hour. The terminals of the small spiral were connected to a telephone fixed in a distant room, the result being that the sound reproduced could be clearly heard and recognised every time the spirals passed each other. With a knowledge of this fact, I think it will be readily understood how a cheap and efficient adjunct to the present system of railway signalling could be obtained by such means as I have ventured to bring to your notice this evening."

---

* Machine of 1882–1883 (old style armature).

In my reply to some of the remarks made by the gentlemen who took part in the discussion, I expressed a hope that those present who were interested in railway signalling would practically make the experiment, as I believed it would be a very cheap system, and answer remarkably well. I am not aware that any such experiments have been made on any of the railways in England, therefore I was much interested in the account which appeared in your last number, of the practical application in America, in February last, of the system proposed by me.

In the experiment it is stated that the "primary circuit" consisted of only *one* wire, laid between the rails, and seven inches beneath the secondary wire attached to the bottom of the car. I should not have expected that under such conditions sufficient induced current for the purpose required would have been obtained from the number of cells mentioned. I have no doubt about the principle, and thoroughly believe that it will in time become an important system of railway signalling, not only between a train in motion and the various stations, but also be the means of enabling the trains running on the same rails to communicate with each other whilst in motion.

Willoughby Smith.

Gutta Percha Company,
18, Wharf Road, City Road, N.
March 9th, 1885.

Battery Questions.

I should be very much obliged if you or any of your readers through the medium of your esteemed journal would inform me where to get all particulars concerning the Lalande-Chaperon battery and that constructed by Messrs. Buchin, Tricoche and Company, mentioned in the last REVIEW'S "Notes."

E. S.

[All information concerning the Lalande-Chaperon battery may be obtained by application to the Standard Electric Light Company, of Lombard Street, London, E.C. Respecting our correspondent's last query we are sorry that we can give no further particulars at present. —EDS. ELEC. REV.]

Telegraphic and Telephonic Circuits.

In reply to "H. E.'s" enquiries under the above head I would point out that "a return wire run about a foot from line wire" would not "*entirely* prevent the inductive effect of the telegraph currents" which might be passing along the telegraph wires attached to the same posts, unless he arranged in some way for both the line and return to be equidistant from any and all the telegraph wires.

The best method is what is generally known as the "twist," and I do not hesitate to support it, having had over two years' experience with it, during which period it never failed to keep silence save when some ordinary fault occurred in the wires, such as contacts, leakages and the like. As your correspondent may possibly be aware of the arrangement of the "twist," I think it will be hardly necessary to take up more of your space than will be needful to point out the importance of using the best insulators; and as the currents induced in the line and return wires are in opposite directions and therefore tend to neutralise one another, the aim in alternately reversing their positions is to equalise their opposite effect and obtain a point of silence, the theory being based on the law of inverse squares.

I will conclude by saying that I never noticed any falling off in the speaking, and I have conversed freely both in an ordinary tone and in a whisper over a length of wire including line and return of 60 miles. Any other information in my power will be willingly given by

Arthur Edgar Cotterell.

Temple Chambers,
18, Temple Row, Birmingham,
9th March, 1885.

The Theories about Electricity.

In reply to Mr. James Johnstone's letter published in the last number of the ELECTRICAL REVIEW, will you allow me to inform him that I am not acquainted with his writings, but that I should be glad if he will refer me to any of his published papers bearing on "Volta-electric induction," as I should much like to read them.

Willoughby Smith.

Gutta Percha Company,
18, Wharf Road, City Road, N.,
March 9th, 1885.

The Edison Receiver.

Could you, or any of your numerous correspondents, kindly inform me as to where I might obtain a disc 4 inches by ¾ inch composed of the same material as the small roller in the Edison receiver, being, as I believe, capable of working without the application of moisture. Failing this, I should feel obliged if you could acquaint me with the nature of the composition and the treatment required.

T. S. H.

Incandescent Lamp Holders.

Referring to your kindly notice of my new lamp-holder, will you permit me to say, with respect to the possibility of the loops on the lamps being bent or injured when being put into the slits by any "side movement," that if the point in the glass bulb be first placed in the loop of the wire support, and the platinum loops be then placed in the nipping slits, no "side movement" of the lamp can take place, as the support holds it perfectly tight on to the top of the body of the holder.

We would also like to call attention to the fact that this holder enables *lamps with broken loops* to be used, if there be the smallest projecting piece of the platinum left on the lamp, so that many cast-aways may now be reinstated to shed their light upon the world.

This alone should cause the holder to be much favoured.

E. Cox-Walker.

March 10th, 1885.

In your issue of the 7th inst. you describe a form of incandescent lamp holder brought out by Messrs. Harrison, Cox-Walker & Co. We would like to know if the holder is efficient when the lamp is held in a downward or horizontal position, and *without the wire support* that passes over the bulb of the lamp.

A twelvemonth since we devised a similar form of holder, whereby the platinum loops of the lamp were held laterally between two jaws that were compressed by means of thumb screws.

We experimented with 30 of them in parallel, the lamps being held in a downward position, and in less than an hour the heat had so contracted the jaws of the holders, that every one of the lamps had dropped out. We consider that there are many objections to the passing of a wire support over the bulb of the lamp, and should be glad to find that some improvement in the material of the jaws, or method of compressing them, has made this undoubted advance in holders practicable.

Faraday & Son.

3, Berners Street, London, W.,
March 11th, 1885.

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